**Remedial Action Contract
for Remedial Response, Enforcement Oversight, and Non-Time Critical Removal Activities at Sites of Release or Threatened Release of Hazardous Substances in EPA Region VIII**

U.S. EPA Contract No. EP-W-05-049

Sampling and Analysis Plan/Quality Assurance Project Plan: Wood-Burning Stove Ash Removal Activity-Based Sampling Libby Asbestos Site, Operable Unit 4

Revision 0 – November 2012

Work Assignment No.:	**329-RICO-08BC Libby Asbestos Superfund Project, OU4 Remedial Investigation/Feasibility Study**
EPA Work Assignment Manager:	**Victor Ketellapper**
CDM Smith Project Manager:	**Nathan Smith**

Prepared for:
**U.S. Environmental Protection Agency
Region VIII
1595 Wynkoop Street
Denver, Colorado 80202**

Prepared by:
**CDM Federal Programs Corporation
555 17th Street, Suite 1100
Denver, Colorado 80202**

A PROJECT MANAGEMENT

A1. Title and Approval Sheet

Title: Sampling and Analysis Plan/Quality Assurance Project Plan: Wood-Burning Stove Ash Removal Activity-Based Sampling, Libby Asbestos Site, Operable Unit 4.

Revision Log:

Revision No.	Date	Description
0	11/2/12	---

Approvals:

Approved by: Nathan Smith — Date: 11/6/12
Nathan Smith
CDM Smith, Project Manager

Approved by: Terry Crowell — Date: 11/6/12
Terry Crowell
CDM Smith, Quality Assurance Coordinator

Approved by: Dania Zinner, on behalf of — Date: 11/6/12
Elizabeth Fagen
EPA Region VIII, Remedial Project Manager

Approved by: ______ — Date: 11/6/12
Victor Ketellapper, P.E.
EPA Region VIII, Libby Asbestos Project Team Leader

A2. Table of Contents

List of Figures

List of Tables

List of Appendices

List of Acronyms and Abbreviations

%	percent
ABS	activity-based sampling
Ago	grid opening area
AHERA	Asbestos Hazard Emergency Response Act
cc	cubic centimeter
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHISQ	chi-squared
cm^{-2}	per square centimeter
COC	chain-of-custody record
DE Tool	data entry tool
DQO	data quality objective
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EDXA	energy dispersive x-ray analysis
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESAT	Environmental Services Assistance Team
f	indirect preparation dilution factor
f/cc	fibers per cubic centimeter
FSDS	field sample data sheet
FTL	field team leader
g	gram
g^{-1}	per gram
GO_x	number of grid openings
GPS	global positioning system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	Health and Safety
HDPE	high density polyethylene
HV	high volume filter
ID	identification

IDW	investigation-derived waste
L	liters
L/cc	liters per cubic centimeter
L/min	liters per minute
LA	Libby amphibole
LADT	Libby Asbestos Data Tool
LC	laboratory coordinator
LV	low volume filter
MDEQ	Montana Department of Environmental Quality
mm	millimeter
mm^2	square millimeters
N	number
'N/A'	not applicable
NFG	National Functional Guidelines
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
PLM	polarized light microscopy
$PM_{2.5}$	particulate matter (2.5 micrometers)
PPE	personal protective equipment
QA	quality assurance
QAM	quality assurance manager
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QATS	Quality Assurance Technical Support
QC	quality control
RPM	Regional Project Manager
ROM	Record of Modification
s/cm^2	structures per square centimeter
s/g	structures per gram
s/cc	structures per cubic centimeter
SAP	sampling and analysis plan

SAED	selective area electron diffraction
Shaw	Shaw Environmental, Inc.
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SPF	sample preparation facility
SRM	standard reference materials
STEL	short-term exposure limit
TEM	transmission electron microscopy
TWA	time-weighted average
USGS	United States Geological Survey
V	sample air volume
µm	micrometers

A3. Distribution List

Copies of this completed and signed sampling and analysis plan/quality assurance project plan (SAP/QAPP) should be distributed to:

U.S. Environmental Protection Agency, Region VIII
1595 Wynkoop Street
Denver, Colorado 80202-1129

- Victor Ketellapper, Ketellaper.Victor@epa.gov (1 hard copy, electronic copy)
- Elizabeth Fagen, Fagen.Elizabeth@epa.gov (electronic copy)
- Don Goodrich, Goodrich.Donald@epa.gov (electronic copy)
- Jeff Mosal, Mosal.Jeffrey@epa.gov (electronic copy)
- Dania Zinner, Zinner.Dania@epa.gov (electronic copy)
- David Berry, Berry.David@epa.gov (electronic copy)

EPA Information Center – Libby
108 East 9th Street
Libby, Montana 59923

- Mike Cirian, Cirian.Mike@epa.gov (1 hard copy, electronic copy)

Montana Department of Environmental Quality
1100 North Last Chance Gulch
Helena, Montana 59601

- Carolyn Rutland, CRutland@mt.gov (electronic copy)
- John Podolinsky, JPodolinsky@mt.gov (electronic copy)

TechLaw, Inc.
ESAT, Region VIII
16194 West 45th Drive
Golden, Colorado 80403

- Doug Kent, Kent.Doug@epa.gov (electronic copy)

CDM Smith – Libby Field Office
60 Port Boulevard, Suite 201
Libby, Montana 59923

- Dominic Pisciotta, pisciottaDM@cdmsmith.com (2 hard copies, electronic copy)
- Terry Crowell, crowellTL@cdmsmith.com (electronic copy)
- Damon Repine, repineDL@cdmsmith.com (electronic copy)

CDM Smith – Denver Office
555 17th Street, Suite 1100
Denver, Colorado 80202

- Nathan Smith, smithNT@cdmsmith.com (electronic copy)

Copies of the SAP/QAPP will be distributed to the individuals above by CDM Federal Programs Corporation (CDM Smith), either in hard copy or in electronic format (as indicated above). The CDM Smith Project Manager (or their designee) will distribute updated copies each time a SAP/QAPP revision occurs. An electronic copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

A4. Project Task Organization

Figure A-1 presents an organizational chart that shows lines of authority and reporting responsibilities for this project. The following sections summarize the entities and individuals that will be responsible for providing project management, technical support, and quality assurance for this project.

A4.1 Project Management

The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency for Superfund activities within the Libby Asbestos Superfund Site (Site). The EPA Region VIII Libby Asbestos Project Team Leader is Victor Ketellapper. The EPA Regional Project Manager (RPM) for this sampling effort is Elizabeth Fagen. The EPA Region VIII Onsite RPM for this sampling effort is Michael Cirian.

The Montana Department of Environmental Quality (MDEQ) is the support regulatory agency for Superfund activities at the Site. The MDEQ Project Manager for this sampling effort is Carolyn Rutland. The EPA will consult with MDEQ as provided for by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan, and applicable guidance in conducting Superfund activities.

A4.2 Technical Support

A4.2.1 SAP/QAPP Development

This SAP/QAPP was developed by CDM Smith at the direction of, and with oversight by, the EPA. This SAP/QAPP contains all the elements required for both a SAP and a QAPP and has been developed in general accordance with the *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA 2001) and the *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4* (EPA 2006).

Copies of the SAP/QAPP will be distributed by the CDM Smith Project Manager (or their designee), either in hard copy or in electronic format, as indicated in Section A3. The CDM Smith Project Manager (or their designee) will distribute updated copies each time a SAP/QAPP revision occurs. An electronic copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

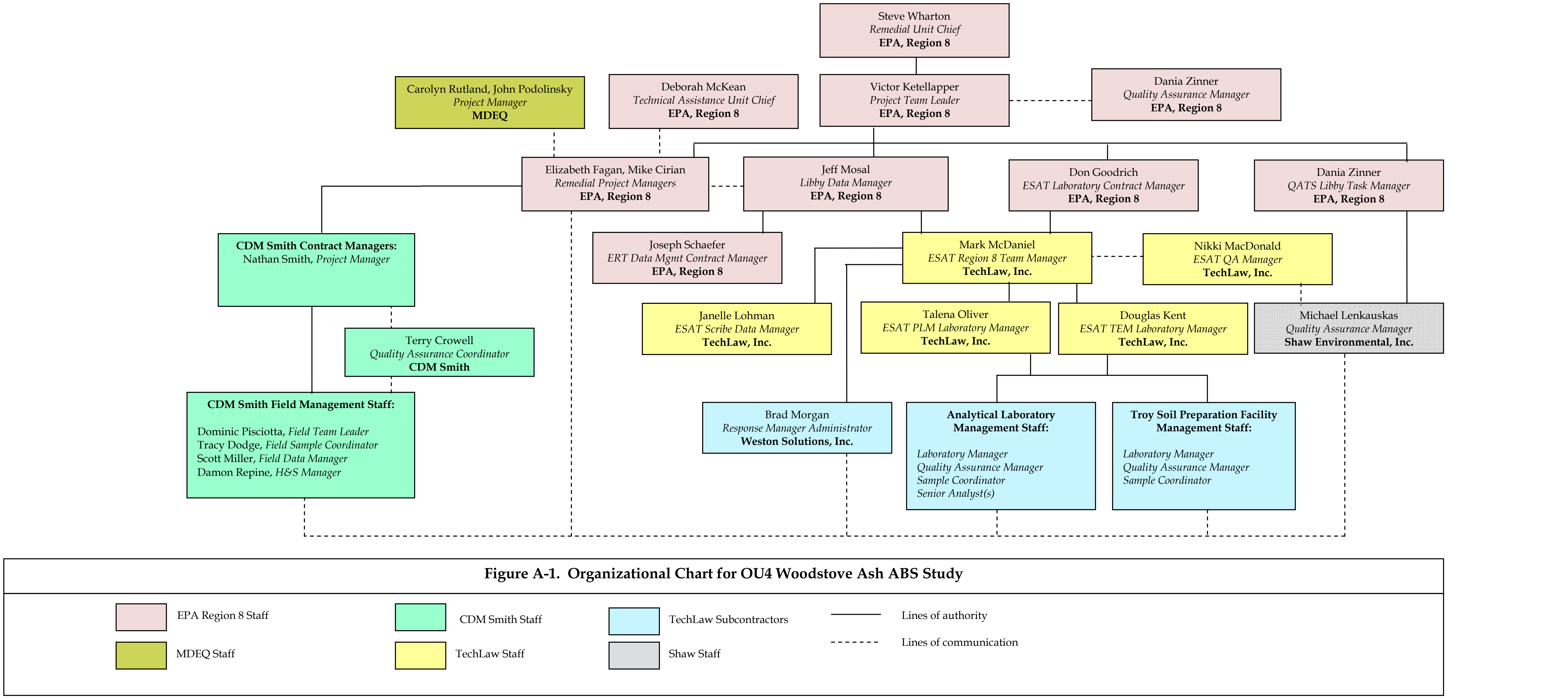


Figure A-1. Organizational Chart for OU4 Woodstove Ash ABS Study

A4.2.2 Field Sampling Activities

CDM Smith will be responsible for conducting all field sampling activities in support of the sampling program described in this SAP/QAPP. Key CDM Smith personnel that will be involved in this sampling program include:

- Nathan Smith, Project Manager
- Dominic Pisciotta, Field Team Leader
- Tracy Dodge, Sample Coordinator
- Scott Miller, Field Data Manager
- Terry Crowell, Quality Assurance Coordinator
- Damon Repine, Health and Safety Manager

A4.2.3 Asbestos Analysis

All samples collected as part of this project will be sent for preparation and analysis for asbestos at laboratories selected and approved by the EPA to support the Site. The EPA Environmental Services Assistance Team (ESAT) is responsible for procuring all analytical and preparation laboratory services and providing direction to the analytical laboratories. Don Goodrich (EPA Region 8) is responsible for managing the ESAT laboratory support contract for asbestos. The ESAT Region 8 Team Manager at TechLaw, Inc. is Mark McDaniel. He is also the designated laboratory coordinator (LC) for the Libby project that is responsible for directing the analytical laboratories, prioritizing analysis needs, and managing laboratory capacity.

A4.2.4 Data Management

All data generated as part of this sampling effort will be managed and maintained in Scribe. The EPA Environmental Response Team (ERT) is responsible for the administration of all Scribe data management aspects of this project. Joseph Schafer is responsible for overseeing the ERT data management support contract. ERT is responsible for the development and management of Scribe and the project-specific data reporting requirements for the Libby project.

The CDM Smith field data manager (Scott Miller) is responsible for uploading sample information to the field Scribe project database. ESAT is responsible for uploading new analytical results to the analytical Scribe project database. The ESAT project data manager for the Libby project is Janelle Lohman (TechLaw, Inc.).

Because of the quantity and complexity of the data collected at the Site, the EPA has designated a Libby Data Manager to manage and oversee the various data support contractors. The EPA Region 8 Data Manager for the Libby project is Jeff Mosal.

A4.3 Quality Assurance

There is no individual designated as the EPA Quality Assurance Manager for the Libby project. Rather, the Region 8 Quality Assurance (QA) program has delegated authority to the EPA RPMs. This means that the EPA RPMs have the ability to review and approve governing investigation documents developed by Site contractors. Thus, it is the responsibility of the EPA RPM for this sampling effort (Elizabeth Fagen), who is independent of the entities planning and obtaining the data, to ensure that this SAP/QAPP has been prepared in accordance with the EPA QA guidelines and requirements. The EPA RPM is also responsible for managing and overseeing all aspects of the quality assurance/quality control (QA/QC) program for this sampling effort. In this regard, the RPM is supported by the EPA Quality Assurance Technical Support (QATS) contractor, Shaw Environmental, Inc. (Shaw). The QATS contractor will evaluate and monitor laboratory QA/QC and is responsible for performing annual audits of each analytical laboratory.

Terry Crowell (CDM Smith) is the field Quality Assurance Coordinator for this project. Ms. Crowell is responsible for evaluating and monitoring field QA/QC, for providing oversight of field sampling and data collection activities, and for designating a qualified individual to conduct the field surveillance (see Section B5.1).

A5. Problem Definition/Background

A5.1 Site Background

Libby is a community in northwestern Montana located 7 miles southwest of a vermiculite mine that operated from the 1920s until 1990. The mine began limited operations in the 1920s and was operated on a larger scale by the W.R. Grace Company from approximately 1963 to 1990. Studies revealed that the vermiculite from the mine contains amphibole-type asbestos, referred to as Libby amphibole (LA).

Epidemiological studies revealed that workers at the mine had an increased risk of developing asbestos-related lung disease (McDonald *et al.* 1986, Amandus and Wheeler 1987, Amandus *et al.* 1987, Sullivan 2007). Additionally, radiographic abnormalities were observed in 17.8 percent (%) of the general population of Libby including former workers, family members of workers, and individuals with no specific pathway of exposure (Peipins *et al.* 2003). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of on-going exposure and risk to current and future residents and workers in the area. The Site was listed on the National Priorities List in October 2002.

A5.2 Reasons for this Project

Previous investigations conducted at the Site have demonstrated that LA is present in environmental source media (e.g., soil, tree bark, duff material) at locations in and around the Site. The EPA has also performed several investigations at the Site to evaluate potential exposures to LA released from source materials by measuring the concentration of LA in breathing zone air during various disturbance activities, referred to as "activity-based sampling" (ABS). These inhalation exposures may pose a risk of cancer and/or non-cancer effects. The purpose of this project is to conduct an ABS to investigate potential residential exposures to airborne LA during ash removal activities from wood-burning stoves.

Wood-burning stoves provide a major source of residential heating in the Kootenai Valley during the cold, winter months. Residents harvest and collect firewood from the surrounding National forest land and from private sources. LA fibers have been detected in the bark of trees located on the former W.R. Grace mine site northeast of Libby and in the bark of trees located in timber lots near Flower Creek Reservoir southwest of Libby. Although residents have been advised to not harvest trees/wood for residential heating in the Kootenai Valley, it is not possible to regulate where an individual might harvest wood for home heating.

Trial burn experiments in wood stoves (Ward *et. al* 2009) and in test burn chambers (EPA 2011a) indicate that the majority of LA fibers are retained in the ash when wood and duff materials are burned under experimental conditions. Removing ash from wood stoves and disposing the contaminated ash as municipal garbage is a potential exposure scenario for residents in Libby. (An institutional control currently in place already addresses disposal of ash in home gardens to guard against potentially re-contaminating a "cleaned" property.)

Hence, data are required to assess whether residents in Libby would be exposed to unacceptable levels of airborne LA from ash generated from burning contaminated wood in residential wood-burning stoves.

A5.3 Applicable Criteria and Action Limits

At the Libby Site, the EPA has developed action levels and cleanup criteria for LA that are applicable to emergency response actions performed at residential/commercial properties (EPA 2003). However, there are no action levels or cleanup criteria that have been developed that are specific to ash or ABS air. Final action levels for the Site will not be developed until completion of the remedial investigation/feasibility study and the publication of the record of decision.

Personal air monitoring of sampling personnel will be performed in accordance with Occupational Safety and Health Administration (OSHA) requirements. In accordance with these requirements, samples will be analyzed for asbestos by phase contrast microscopy (PCM) and compared to the OSHA limits for workplace exposures. The short-term (15-minute) exposure limit (STEL) is 1.0 fiber per cubic centimeter of air (f/cc), and the long-term time-weighted average (TWA) exposure limit is 0.1 f/cc.

A6. Project/Task Description

A6.1 Task Summary

Basic tasks that are required to implement this SAP/QAPP include burning wood for home heating in a wood-burning stove and collecting ABS air using an ABS sampling scenario emulating a person emptying the ash from the stove, to assess the presence of LA fibers in the air and potential for human exposures. An ash sample will be collected prior to the stove-emptying activity. Tree bark samples will also be collected prior to burning to verify that the trees selected for firewood collection represent a range of LA concentrations. Based on the assumption that tree bark concentrations of LA will decreases as a function of distance from the mine, wood for burning will be collected from three locations, representing a range of distances from the source (near, intermediate, and far). Perimeter air monitoring will also be conducted during the wood burning and stove-emptying events. These basic tasks are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

The work schedule for performing these tasks begins with the felling of deadwood trees for firewood collection in areas varying in distance from the source (near, intermediate, and far), under the assumption that tree bark concentration decreases as a function of distance from the mine. Felled trees will be cut into log sizes appropriate for firewood. This wood will be utilized for enactment of the ABS scenario, which is anticipated to occur in the fall of 2012. Following sample analysis, data evaluation and interpretation tasks will be performed in late winter of 2012.

A6.3 Locations to be Evaluated

Location selection for the collection of trees is described in Section B1.1. All ABS activities will be performed at the Lincoln County landfill in Libby.

A6.4 Resources and Time Constraints

There are both resource and time constraints associated with the scope of this sampling program. Because ABS activities will be performed inside a temporary enclosure the timing of the ABS effort may be performed at any time, but the goal is to collect air samples that are optimal for the release of LA fibers from ash (i.e., low humidity), thus ABS activities should be performed when the weather is dry.

Due to the amount of funding allocated for this project, this sampling program will be limited to an evaluation of firewood collected from three locations. In addition, the study budget will limit the level of field support to no longer than 9 days of sampling support.

A7. Quality Objectives and Criteria

A7.1 Data Quality Objectives

Data quality objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and types of analyses to be performed. The EPA has developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific decision-making (EPA 2001, 2006).

Appendix A provides the detailed implementation of the seven-step DQO process associated with this SAP/QAPP.

A7.2 Performance Criteria

The range of LA concentrations that will occur in ABS air during ash removal activities is not known. However, it is possible to estimate the concentration levels that correspond to a level of human health concern. These calculations are provided as part of the DQOs (see **Appendix A**). The analytical requirements for LA measurements in ABS air as established in Section B4 ensure concentrations will be reliably detected and quantified if present at levels of concern.

A7.3 Precision

The precision of asbestos measurements is determined mainly by the number (N) of asbestos structures counted in each sample. The coefficient of variation resulting from random Poisson counting error is equal to $1/N^{0.5}$. In general, when good precision is needed, it is desirable to count a minimum of 3-10 structures per sample, with counts of 20-25 structures per sample being optimal.

Recount and repreparation analyses will be performed as part of the TEM analysis (see Section B5.2.3). These analyses will provide information on analysis reproducibility and precision (both inter- and intra-laboratory).

A7.4 Bias and Representativeness

There is no established set of reference materials or spiked standards that can be used to assess accuracy of TEM analyses of LA in air. Results for field blanks and laboratory blanks will be utilized to ensure that air sample results are not biased as a consequence of cross-contamination due to field sampling procedures or preparation and analysis methods.

It is expected that LA levels in ABS air may vary widely as a function of the level of LA in the source materials disturbed, the types of activities performed, and meteorological conditions. This ABS study is intended to represent the range of potential exposure conditions, through the evaluation of trees from locations both near and far from the mine. The ABS air sample collection will be performed under simulated activities that are representative of the types of activities that may actually be performed by residents when cleaning out a wood-burning stove.

In addition, the study will use one of the newly EPA-certified woodstoves suitable for home use. Because the EPA-certified woodstove reduces the amount of particulate matter 2.5 micrometers ($PM_{2.5}$) and smaller in indoor air compared to older woodstove models, the amount of LA in the ash in the study will be more concentrated than ash removed from an older woodstove that may be present in a residential home. Therefore, while the study results may be representative of homes who have changed over to the newer woodstoves, the measured LA concentrations in ABS air may be higher than that from homes with the older woodstoves.

Another potential bias in the source (ash) LA concentrations is the burning of the tree bark along with the collected wood. LA levels are likely to be highest in the tree bark (relative to the levels in the underlying wood). For this study, the bark will be left on the firewood during burning to reflect a "worst case" scenario. Thus, LA concentrations in the residual ash and ABS air generated from this study may be higher than if the bark were removed.

A7.5 Completeness

Target completeness for this project is 100%. If any samples are not collected, or if LA analysis is not completed successfully, this could result in that portion of the study providing no useful information. In this event, additional sampling may be needed to support EPA decision-making.

A7.6 Comparability

The data generated during this study will be obtained using standard analytical methods for LA that have been utilized previously in other studies, and will yield data that are comparable to previous analyses of LA in ABS air, perimeter air, ash, and tree bark.

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for LA analysis of each medium is discussed in Section B4.

A8. Special Training/Certifications

A8.1 Field

Asbestos is a hazardous substance that can increase the risk of cancer and serious non-cancer effects in people who are exposed by inhalation. Therefore, all individuals involved in the collection of samples must have appropriate training. Prior to starting any field work, any new field team member must complete the following, at a minimum:

Training Requirement	**Location of Documentation Specifying Training Requirement Completion**
Read and understand the governing Health and Safety Plan (HASP)	HASP signature sheet
Attend an orientation session with the field health and safety (H&S) manager	Orientation session attendance sheet
Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and relevant 8-hour refreshers	OSHA training certificates
Current 40-hour HAZWOPER medical clearance	Physician letter in the field personnel files
Respiratory protection training, as required by 29 CFR 1910.134	Training certificate
Asbestos awareness training, as required by 29 CFR 1910.1001	Training certificate
Sample collection techniques	Orientation session attendance sheet

All training documentation will be stored in the CDM Smith field office. It is the responsibility of the field H&S manager to ensure that all training documentation is up-to-date and on-file for each field team member.

Prior to beginning field sampling activities, a field planning meeting will be conducted to discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required quality control (QC) measures
- Health and safety requirements

It is the responsibility of each field team member to review and understand all applicable governing documents associated with this sampling program, including this SAP/QAPP, all associated standard operating procedures (SOPs) (see **Appendix B**), and the applicable HASP.

A8.2 Laboratory

A8.2.1 Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Each laboratory is accredited by the National Institute of Standards and Technology (NIST)/National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of airborne asbestos by transmission electron microscope (TEM) and/or analysis of bulk asbestos by polarized light microscopy (PLM). This includes the analysis of NIST/NVLAP standard reference materials (SRMs), or other verified quantitative standards, and successful participation in two proficiency rounds per year each of bulk asbestos by PLM and airborne asbestos by TEM supplied by NIST/NVLAP.

Copies of recent proficiency examinations from NVLAP or an equivalent program are maintained by each participating analytical laboratory. Many of the laboratories also maintain certifications from other state and local agencies. Copies of all proficiency examinations and certifications are also maintained by the LC.

Each laboratory working on the Libby project is also required to pass an on-site EPA laboratory audit. The details of this EPA audit are discussed in Section B5.3.3. The LC also reserves the right to conduct any additional investigations deemed necessary to determine the ability of each laboratory to perform the work. Each laboratory also maintains appropriate certifications from the state and possibly other certifying bodies for methods and parameters that may also be of interest to the Libby project. These certifications require that each laboratory has all applicable state licenses and employs only qualified personnel. Laboratory personnel working on the Libby project are reviewed for requisite experience and technical competence to perform asbestos analyses. Copies of personnel resumes are maintained for each participating laboratory by the LC in the Libby project file.

A8.2.2 Laboratory Team Training/Mentoring Program

<u>Initial Mentoring</u>

The orientation program to help new laboratories gain the skills needed to perform reliable analyses at the Site involves successful completion of a training/mentoring program that was developed for new laboratories prior to their analysis of Libby field samples. All new laboratories are required to participate in this program. The training program includes a rigorous 2-3 day period of on-site training provided by senior personnel from those laboratories already under contract on the Libby project, with oversight by the QATS contractor. The tutorial process includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on project-specific analytical methodology, documentation, and administrative procedures used on the Libby site. The mentor will also review the analysis of at least one sample by each type of analytical method with the trainee laboratory.

Site-specific Reference Materials

Because LA is not a common form of asbestos, U.S. Geological Survey (USGS) prepared Site-specific reference materials using LA collected at the Libby mine site (EPA 2008a). Upon entry into the Libby program, each laboratory is provided samples of these LA reference materials. Each laboratory is required to analyze multiple LA structures present in these samples by TEM in order to become familiar with the physical and chemical appearance of LA and to establish a reference library of LA Energy Dispersive Spectroscopy (EDS) spectra. These laboratory-specific and instrument-specific LA reference spectra (EPA 2008b) serve to guide the classification of asbestos structures observed in Libby field samples during TEM analysis.

Regular Technical Discussions

On-going training and communication is an essential component of QA for the Libby project. To ensure that all laboratories are aware of any technical or procedural issues that may arise, a regular teleconference is held between the EPA, their contractors, and each of the participating laboratories. Other experts (e.g., USGS) are invited to participate when needed. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications.

Professional/Technical Meetings

Another important aspect of laboratory team training has been the participation in technical conferences. The first of these technical conferences was hosted by USGS in Denver, Colorado, in February 2001, and was followed by another held in December 2002. The Libby laboratory team has also convened on multiple occasions at the ASTM Johnston Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conference in San Antonio, Texas in January 2010. In addition, members of the Libby laboratory team attended an EPA workshop to develop a method to determine whether LA is present in a sample of vermiculite attic insulation held in February 2004 in Alexandria, Virginia. These conferences enable the Libby laboratory and technical team members to have an on-going exchange of information regarding all analytical and technical aspects of the project, including the benefits of learning about developments by others.

A8.2.3 Analyst Training

All TEM analysts for the Libby project undergo extensive training to understand TEM theory and the application of standard laboratory procedures and methodologies. The training is typically performed by a combination of personnel, including the laboratory manager, the laboratory quality assurance manager (QAM), and senior TEM analysts.

In addition to the standard TEM training requirements, trainees involved with the Libby project must familiarize themselves with Site-specific method deviations, project-specific documents, and visual references. Standard samples that are often used during TEM training include known pure (traceable) samples of chrysotile, amosite, crocidolite, tremolite, actinolite and anthophyllite, as well as fibrous non-asbestos minerals such as vermiculite, gypsum, antigorite, kaolinite, and sepiolite. New TEM analysts on the Libby project are also required to perform an EDS spectra characterization evaluation (EPA 2008b) on the LA-specific reference materials provided during the initial training program to aide in LA mineralogy recognition and definition. Satisfactory completion of each of these tasks must be approved by a senior TEM analyst.

All TEM analysts are also trained in the Site-specific laboratory QA/QC program requirements for TEM (see Section B5.3.4). The entire program is discussed to ensure understanding of requirements and responsibilities. In addition, analysts are trained in the project-specific reporting requirements and data reporting tools utilized in transmitting results. Upon completion of training, the TEM analyst is enrolled as an active participant in the Libby laboratory program.

A training checklist or logbook is used to assure that the analyst has satisfactorily completed each specific training requirement. It is the responsibility of the laboratory QAM to ensure that all TEM analysts have completed the required training requirements.

A9. Documentation and Records

A9.1 Field

Field teams will record sample information on the most current version of the Site-specific field sample data sheets (FSDSs) developed for each medium[1]. Section B3.1.2 provides detailed information on the documentation requirements for FSDS forms. In brief, the FSDS forms document the unique sample identifier assigned to every sample collected as part of this program. In addition, the FSDSs provide information on whether the sample is representative of a field sample or a field-based QC sample (e.g., field blank, field duplicate).

[1] The most recent version of the FSDS forms are provided in the Libby Field eRoom.

A9.2 Laboratory

All preparation and analytical data for asbestos generated in the laboratory will be documented on Site-specific laboratory bench sheets and entered into a database or spreadsheet electronic data deliverable (EDD) for submittal to the data managers. Section B4.2 provides detailed information on the requirements for laboratory documentation and records.

A9.3 Logbooks and Records of Modification/Deviations

It is the also responsibility of the field team and analytical laboratory staff to maintain logbooks and other internal records throughout the sample lifespan as a record of sample handling procedures. Significant deviations (i.e., those that impact or have the potential to impact investigation objectives) from this SAP/QAPP, or any procedures referenced herein governing sample handling, will be discussed with the EPA Project Manager (or their designee) and the CDM Smith Project Manager prior to implementation. Such deviations will be recorded on a Record of Modification (ROM) form. Sections B5.1.2 and B5.2.2 provide detailed information on the procedures for preparing and submitting ROMs by field and analytical laboratory personnel, respectively.

B DATA GENERATION AND ACQUISITION

B1. Study Design

B1.1 Locations

B1.1.1 Tree Collection Locations

This study seeks to collect ABS air samples during simulated activities designed to mimic potential exposures during the removal of ash from a wood-burning stove. Trees that will be burned in the wood-burning stove to generate the ash will be collected from locations at varying distances from the OU3 mine (source) to provide a range of LA concentrations for the ABS scenario.

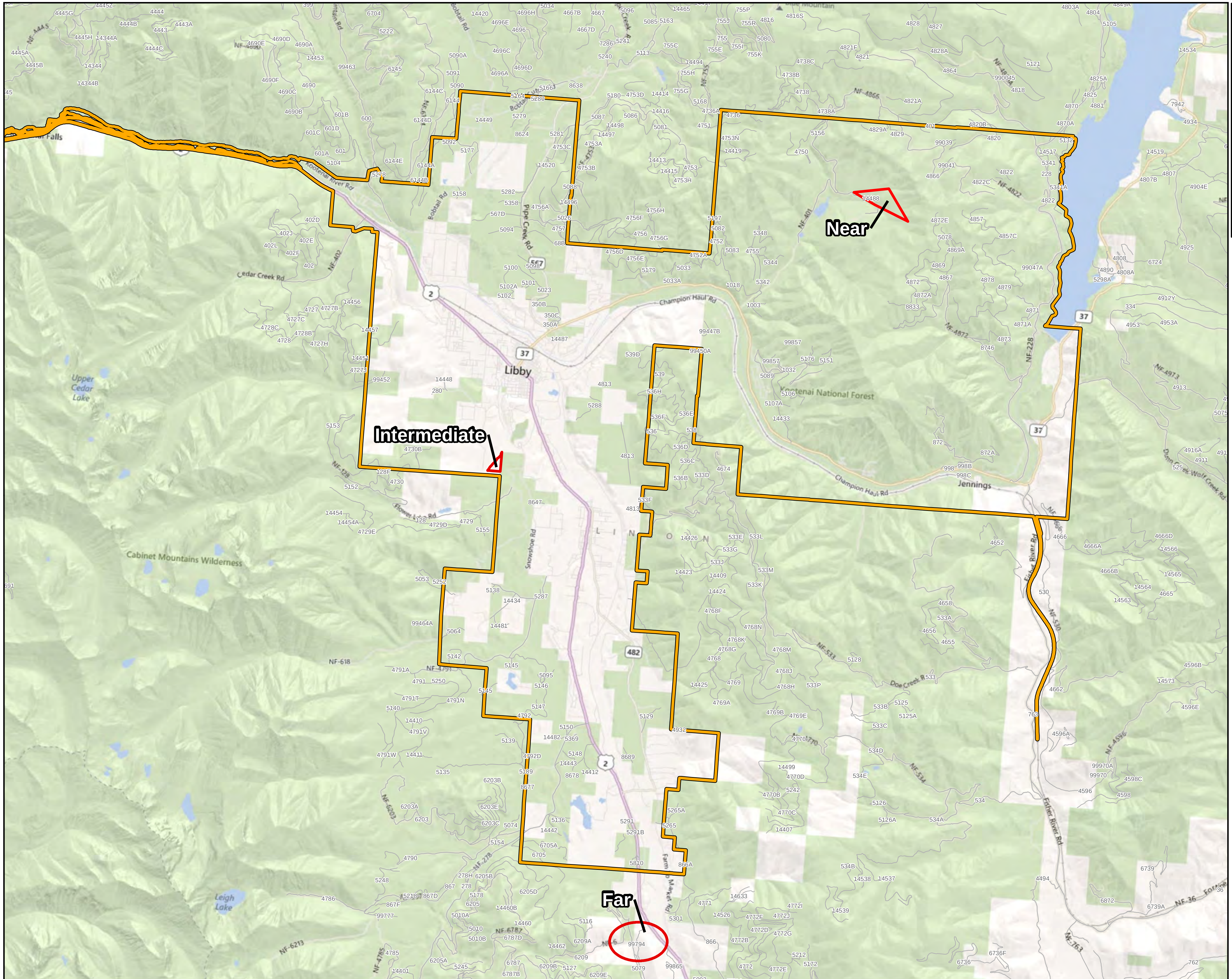
A total of three locations have been selected for evaluation. Locations were selected to be representative of a range of distances from the source (near, intermediate, and far), under the assumption that the tree bark LA concentration decreases as a function of distance from the mine. This assumption is supported by measured LA concentrations for tree bark collected during previous sampling efforts. Locations are placed in areas that are accessible via forest service roads and that appear to have adequate tree cover (based on a cursory review of aerial images):

- "Near" Location – In the vicinity of the mine in OU3, located in an area with high LA levels measured in duff and tree bark (collocated with the area evaluated as part of the *OU3 Commercial Logging ABS Study* [CDM Smith 2012a]).

- "Intermediate" Location – In the vicinity of Flower Creek (collocated with the area that will be evaluated as part of the *Opportunistic Commercial Logging Study* [CDM Smith 2012b]).

- "Far" Location – A location a few miles south of Flower Creek (near a sampling point outside the NPL boundary evaluated as part of the *Nature & Extent of LA Contamination in the Forest Study* [CDM Smith 2012c])

Figure B-1 identifies the selected locations. Should these pre-determined locations become inaccessible at any point during or prior to the sampling event, new locations that meet the same criteria will be identified and presented to the EPA for approval. These changes would be documented on a ROM form as described in Section B5.1.



Legend

- Tree Collection Location
- Libby Asbestos NPL Boundary
- Forest Service Roads

N
W E
S

Miles

0 1 2 4

1 inch = 2 miles

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Base - Microsoft Bing (2011)

For Official Use Only

Figure B-1

Tree Collection Locations

CDM Smith

Path: R:\2603-Volpe\SAP\FigureB-1_TreeCollectionLocations_120925.mxd

B1.1.2 ABS Area

ABS activities will be conducted inside a temporary tent enclosure in the vicinity of the Libby landfill. The wood-burning stove will be placed inside the enclosure to simulate an indoor condition. At this location, the stove-emptying ABS scenario will be repeated several times for the varying wood samples collected near, intermediate, and far from the source. **Appendix C** provides a detailed description of the ABS script for the scenario.

B1.2 Sampling Design

The following provides an overview of the sampling effort that will be conducted. Detailed information on sampling procedures and methods are presented in Section B2.

Sampling will begin with the felling of two standing deadwood trees from each of three locations varying in distance from the mine. Selected trees should be Douglas fir that are 8 inches in diameter[2] or larger, to ensure that the tree was present during the mine operation period (pre-1990). The felled trees will be cut to size (i.e., for use in a wood-burning stove). No seasoning time is anticipated since deadwood trees are being used. Thus, tree-felling activities may be performed the day before the wood is to be burned.

Wood will be transported in plastic bags used for containing investigation-derived waste (IDW) to a 10 foot by 10 foot temporary tent enclosure outfitted with a new EPA-certified wood-burning stove constructed in the general vicinity of the Libby landfill. The temporary structure will be constructed of posts with polyvinyl sheeting to serve as walls. Due to the potential heat generated by the woodstove during burning, the temporary walls will only be in place for the ABS stove-emptying activities. During wood burning, the enclosure will not have any walls so that the heat generated by the stove can dissipate into the open air.

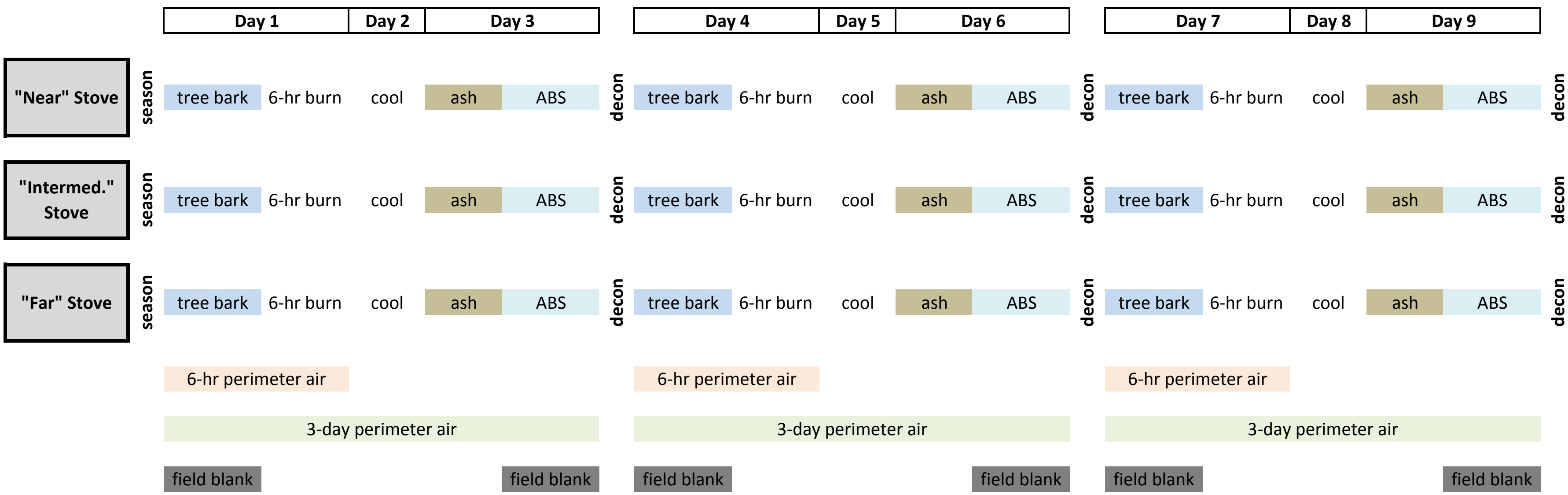
A total of three new EPA-certified wood-burning stoves will be purchased (one stove will be dedicated to each location). Before first use, each wood-burning stove will be “seasoned” per the manufacturer instructions to remove any manufacturing oils. This seasoning process will be performed using firewood obtained from outside of the Libby Valley (e.g., Helena or Kalispell). Following the seasoning burn, the resulting ash will be removed and the inside of the stove will be decontaminated. In addition, the bricks that are usually placed inside the stove for fire protection will be removed as they will not be used during the ABS event. The air in the flue will be filtered prior to release to the external air to minimize any potential particulate releases. Each stove will have its own temporary enclosure and only the firewood from location assigned to each stove (near, intermediate, or far) will be stored in the enclosure.

Three ABS events will be performed sequentially for each woodstove (location) as illustrated in **Figure B-2**.

---

[2] Tree diameter at breast height (dbh)

Figure B-2. Illustration of Woodstove Ash ABS Study Design



Note: For the ABS air samples, a high volume and low volume filter will be collected for each event.

Prior to burning, one tree bark composite sample from each load of logs placed in the stove will be collected (see Section B2.1.3). Thus, a total of nine tree bark composite samples will be collected (one tree bark composite sample per location for each of three ABS events for each of locations) (see **Figure B-2**). In addition, wood moisture content will be measured using a portable moisture meter. Moisture readings should be taken from the freshly cut face of the internal portions of three logs prior to burning. Moisture content readings should be recorded in the field logbook.

Firewood will be continuously burned in the woodstove over a six-hour period. Temperature readings should be taken periodically during the burn to help assess if the wood is burning within an optimal range. Burn temperature readings should be recorded in the field logbook. Adjustments to the flue and/or intakes should be made to keep the burn temperature in an optimal range. The amount of wood burned during the first event will be tracked so that the same amount of wood is used for subsequent burning events. After the six-hour period, the ash should be allowed cool. The ash grab sample should be collected prior to conducting the ABS activity. A total of nine ash samples will be collected (one ash sample per location for each of three ABS events for each of three locations) (see **Figure B-2).**

Following the burning of the logs in the wood stove, and after the ash has cooled, the ABS air sampling event will be conducted. Prior to the ABS activity, the temporary polyvinyl walls should be erected enclosing the woodstove with the woodstove's ventilation routed to the outdoors (similar to how it would be installed in a home). One individual will participate in the ABS stove-emptying scenario. This individual will engage in activities intended to simulate the emptying of ash material from the woodstove into an ash bucket. This individual will wear two different sampling pumps – a high volume pump and a low volume pump. Thus, each ABS event will include the collection of two stove-emptying ABS air samples – one with a high volume pump and one with a low volume pump. As illustrated in **Figure B-2**, three ABS events will be conducted for each tree location. Thus, a total of six stove-emptying ABS air samples will be collected for each location (two ABS air samples for each of three events). Only one of the two air filters for each ABS event, either the high volume or the low volume, will be analyzed by TEM (see Section B4).

In addition to the ABS air samples, perimeter air samples will be collected from a stationary air monitor placed at the perimeter of the landfill in a downwind direction from the woodstove to monitor any potential releases. Two perimeter air samples will be collected for each ABS event. It is anticipated that each ABS event will last approximately three days – one day to burn the wood, one day to let the ash cool, and one day to perform the ABS event (see **Figure B-2**). One perimeter air sample will have a sample duration that encompasses the entire three days of the ABS event (i.e., the duration of the burning, cooling, ABS activities). The other perimeter air sample will be collected only during the 6-hour burning time period for rapid turn-around analysis to monitor potential releases from the woodstoves during the burning activity. Thus, a total of three 3-day perimeter air samples and three 6-hour perimeter air samples will be collected (two perimeter air samples for each of three ABS events) (see **Figure B-2**).

The requirements for field QC sample collection are discussed in Section B5.1.

Table B-1: Number of Samples per Medium

Medium	Number of samples collected per tree location	Total number of samples collected (across locations)	Number of samples analyzed (across locations)
Tree Bark	3	9	9
Ash	3	9	9
Perimeter Air (6-hour)	1	3	3+
Perimeter Air (3-day)	1	3	3
ABS Air	6 (3 HV, 3 LV)	18	9*

+ Rapid turn-around analysis
* Either the HV or LV will be selected for analysis, depending upon filter loading.
ABS = activity-based sampling
HV = high volume filter
LV= low volume filter

B1.3 Study Variables

The level of asbestos in ABS air under source disturbance activities can depend on factors that vary seasonally (e.g., air temperature, humidity). The study intent is to create a temporary enclosure at the Libby landfill and place the woodstove inside the enclosure to simulate an indoor condition. The exact dates have not yet been set, however it is anticipated that this sampling program will occur in October 2012. This timeframe will be consistent with when residents are expected to begin using their woodstoves for heat; thus environmental conditions during the ABS event should be representative of conditions during authentic activity times.

B1.4 Critical Measurements

The critical measurement associated with this project is the measurement of the concentration of LA in ABS air. The analysis of LA in other media, while desirable to monitor potential unintended releases (perimeter air) and levels in the source materials (tree bark, ash), these measurements are less critical. The analysis of LA may be achieved using several different types of microscope, but the EPA generally recommends using TEM because this technique has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile). In addition, analysis by TEM provides structure-specific dimensions that allow for the estimation of PCM-equivalent[3] (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks from the ABS air samples.

[3] PCME structures have a length greater than 5 micrometers (µm), width greater than or equal to 0.25 µm, and an aspect ratio greater than or equal to 3:1.

B1.5 Data Reduction and Interpretation

ABS air filters collected as part of this study will be used to prepare grids for TEM examination (see Section B4). From this examination, the total number of PCME LA structures observed is recorded and the ABS air concentration is calculated as follows:

$$Cair = (N \cdot EFA) / (GOx \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

Cair	= Air concentration (structures per cubic centimeter [s/cc])
N	= Number of PCME LA structures observed (structures)
EFA	= Effective filter area (square millimeters [mm^2])
GOx	= Number of grid openings examined
Ago	= Area of a grid opening (mm^2)
V	= Sample air volume (liters [L])
1000	= L/cc (conversion factor in liters per cubic centimeter)
f	= Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Data for PCME LA concentrations in ABS air will be used to evaluate potential human health risks from woodstove-emptying activities.

B2. Sampling Methods

B2.1 Sample Collection

The following subsections provide investigation-specific requirements for sample collection. A list of general field equipment that will be used to perform this sampling is provided in each of the field sampling SOPs. A medium- and investigation-specific equipment list is provided in Section B8.1 of this SAP/QAPP.

As part of this investigation, personal air samples will also be collected for ongoing health and safety monitoring. The health and safety samples will be collected using an additional low volume sampling pump and are not intended for use as ABS air samples. To differentiate these samples from the other personal air samples collected as part of this sampling effort, 'PA-EXC' or 'PA-TWA' will be selected in the Sample Air Type field of the FSDS to distinguish these personal air-excursion and personal air-time-weighted average samples, respectively. These samples will be collected and analyzed in accordance with the *Response Action SAP* (CDM Smith 2011) and will represent both the TWA and STEL sampling periods.

B2.1.1 ABS Air

ABS air samples will be collected, handled, and documented in general accordance with Site-specific standard operating procedure (SOP) EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air* (see **Appendix B**). In addition, the following investigation-specific requirements apply for ABS air samples collected under this SAP/QAPP.

During every event, each actor will wear two different sampling pumps – a high volume pump and a low volume pump – to allow for the collection of two "replicate" filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes). The high volume pump will be an F&J L-15P, or equivalent, and the low volume pump will be an SKC 224-PCXR4, or equivalent. The appropriate flow rate for each sampling pump will be optimized to achieve the highest sample air volume possible without causing the filter to become overloaded. Initially, the high volume pump flow rate will be 5.5 liters per minute (L/min) and the low volume pump flow rate will be 2.0 L/min. Only one of the two resulting air samples from each actor will be selected for analysis (see Section B4).

During the ABS event, pump flow rates will be verified at 30-minute intervals or when participants are relieved from an activity by a backup participant, whichever occurs sooner. See Section B6/B7.1 for details regarding pump calibration.

B2.1.2 Perimeter Air

All perimeter air samples will be collected in accordance with the project-specific SOP EPA-LIBBY-2012-10, *Air Sample Collection* (see **Appendix B**). The 6-hour perimeter air samples collected during each burning event, will be collected at a flow rate of 5.0 L/min; thus, it is expected that each sample will have a total sample volume of about 1,800 liters (L). The 3-day perimeter air samples collected for each ABS duration (across the 3 days of burning, cooling, and ABS), will be collected at a flow rate of 2.5 L/min; thus, it is expected that each sample will have a total sample volume of about 10,800 L.

B2.1.3 Tree Bark

Tree bark samples will be collected, handled, and documented in general accordance with Site-specific SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix B**), with the following project modifications:

- Bark samples need not be collected from a particular side of the tree; samples should be collected after the tree has been felled and cut to size and prior to burning in the woodstove.
- Trees selected for sampling will be deadwood trees that are Douglas fir with a diameter of at least 8 inches (dbh). If these trees are not available near the selected sample

location, the sampling team will preferentially select deadwood trees in the area with a large diameter and rough bark.

- Selected trees will be felled, so flagging tape/identification (ID) tags will not be left on the trees. Global positioning system (GPS) coordinates will be collected for each tree location.
- Bark sample information will be recorded on the soil FSDS (the soil FSDS is designed to accommodate multiple media).
- The collection of tree age cores is not necessary for this project.

In brief, two deadwood trees should be felled from each location (i.e., near, intermediate, far). Felled trees should be sawed/split such that they are an appropriate size for burning in a woodstove. Prior to burning the collected wood, a hole saw and chisel will be used to collect five circular bark cores from the wood to be burned, which will be composited into a single sample for analysis of LA by TEM (see Section B4). A total of three composite tree bark samples (one per burning event) will be collected for each location.

B2.1.4 Ash

There is no existing SOP for the collection of ash material. After the wood has been burned and the ash has cooled, the ash should be manually mixed (using a long-handled shovel), and an aliquot of approximately 10-20 grams of ash will be placed into a 20-mL glass scintillation vial and shipped to the analytical laboratory for analysis of LA by TEM (see Section B4). Ash sample information will be recorded on the soil FSDS (the soil FSDS is designed to accommodate multiple media). A total of three ash samples (one per burning event) will be collected for each location.

B2.2 Global Positioning System Coordinate Collection

GPS location coordinates will be recorded in basic accordance with Site-specific SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (see **Appendix B**). For this investigation, GPS coordinates will be collected from a location immediately adjacent to each tree selected for felling.

GPS coordinates will be collected as Sample Points, requiring the input of sample identification (ID) (also referred to as index ID) and location ID. Since multiple samples may be attributed to one area, for this sampling program the sample ID will be input as 'N/A'.

Field-collected GPS data are converted to a usable geographic information system (GIS) format using the general processes described in SOP CDM-LIBBY-09. After the conversion from GPS points to GIS files, 100% of the data is checked visually to identify any potential data entry errors.

B2.3 Equipment Decontamination

B2.3.1 Sampling Equipment

Equipment used to collect, handle, or measure environmental samples will be decontaminated in basic accordance with Site-specific SOP EPA-LIBBY-2012-04, *Field Equipment Decontamination at Nonradioactive Sites* (see **Appendix B**). Materials used in the decontamination process will be disposed of as IDW as described below. This SOP specifies the minimum procedural requirements for equipment decontamination. Additional equipment decontamination procedures are also specified in the medium-specific collection SOPs.

B2.3.2 Enclosure and Woodstove

Decontamination of the temporary enclosure and woodstove should be performed between each stove-emptying event. Enclosure walls should be decontaminated or replaced before conducting stove-emptying activities from a new firewood collection area. The woodstove will be decontaminated by rinsing the interior walls and bottom with water and using a wet/dry vacuum to remove the rinsate water. This process will be repeated as necessary to remove as much of any residual ash and burn materials as possible. The woodstove rinsate water will be directed into the landfill cell for final disposal.

B2.4 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in general conformance with Site-specific SOP EPA-LIBBY-2012-05, *Guide to Handling of Investigation-Derived Waste* (see **Appendix B**). In brief, IDW will be double-bagged, with the outer bag being a clear heavy-weight trash bag that has been pre-printed with 'IDW' on the outside. If pre-printed IDW bags are not available, the outer bag needs to be clearly labeled (once) using an indelible marker or a taped label. All IDW generated during this sampling program will enter the waste stream at the local class IV asbestos landfill.

B3. Sample Handling and Custody

B3.1 Sample Identification and Documentation

B3.1.1 Sample Labels

Samples will be labeled with sample ID numbers supplied by field administrative staff and will be signed out by the sampling teams. For air samples, the labels will be affixed to the sample cassette and the inside of the sample bag. For tree bark, the labels will be affixed to the inside of both the inner and outer sample bags and the sample ID number will be written in indelible ink on the outside of each bag. For ash, the labels will be affixed to the outside of the glass bottle.

Sample ID numbers will identify the samples collected during this sampling effort using the following format:

WA-#####

where:

WA = Prefix that designates samples collected under this **W**oodstove **A**sh SAP/QAPP
= A sequential five-digit number

B3.1.2 Field Sample Data Sheets

As noted previously in Section A9, field teams will record sample information on the most current version of the Site-specific FSDS. Use of standardized forms ensures consistent documentation across samplers. Hard copy FSDSs are location-specific and allow for the entry of up to three individual samples from the same location on the same FSDS form. If columns are left incomplete due to fewer than three samples being recorded on a sheet, the blank columns will be crossed out, dated, and signed by the field team member completing the FSDS. Erroneous information recorded on a hard copy FSDS will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

FSDS information will be completed in the field before field personnel leave the sampling location. To ensure that all applicable data is accurately entered and all fields are complete, a different field team member will check each FSDS. The team member completing the hard copy form and the team member checking the form will initial the FSDS in the proper fields. In addition, the field team leader (FTL) will also complete periodic checks of FSDSs prior to relinquishment of the samples to the field sample coordinator. Once FSDSs and samples are relinquished to the field sample coordination staff, the FSDSs are again checked for accuracy and completeness when data are input into the local Scribe field database.

If a revision is required to the hard copy FSDS during any of these checks, it will be returned to the field team member initially responsible for its completion. The error will be explained to the team member and the FSDS corrected. If the team member is no longer on-site, revisions will be made by sample coordination staff or the FTL. It is the responsibility of the field data manager to make the appropriate change in the local Scribe field database.

Each hard copy FSDS is assigned a unique sequential number. This number will be referenced in the field logbook entries related to samples recorded on individual sheets. Field administrative staff will manage the hard copy FSDSs in their respective field office. Original

FSDSs will be filed by medium and FSDS number. Hard copies of all FSDS forms will also be sent to the CDM Smith office in Denver, Colorado for archive.

B3.1.3 Field Logbooks

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing documents. Field logbooks will be maintained in general conformance with Site-specific SOP EPA-LIBBY-2012-01, *Field Logbook Content and Control* (see **Appendix B**). In addition to general logbook content requirements outlines in the SOP, the pump calibration and flow rate verification should also be recorded.

Separate field logbooks will be kept for each investigation and the cover of each field logbook will clearly indicate the name of the investigation and its sequence number. Field logbooks will be completed for each investigation activity prior to leaving a sampling location. Field logbooks will be checked for completeness and adherence to SOP requirements on a daily basis by the FTL (or their designee) for the first week of each investigation. When incorrect field logbook completion procedures are discovered during these checks, the errors will be discussed with the author of the entry and corrected. Erroneous information recorded in a field logbook will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

The field administrative staff will manage the field logbooks by assigning unique identification numbers to each field logbook, tracking to whom and the date each field logbook was assigned, the general investigation activities recorded in each field logbook, and the date when the field logbook was returned. As field logbooks are completed, originals will be catalogued and maintained by the field administrative staff in their respective field office. Scanned copies of field logbooks will be maintained on the local server of the CDM Smith office in Libby.

B3.1.4 Photographs and Video

Photographic documentation will be collected with a digital camera in general conformance to SOP EPA-LIBBY-2012-02, *Photographic Documentation of Field Activities* (see **Appendix B**). Photographs should be taken to document representative examples of ABS scenarios performed, sampling locations, site conditions during ABS activities, pre-sampling conditions, and at any other special conditions or circumstances that arise during the activity. Electronic captions will be used to describe the photographs instead of maintaining photographic logs in daily logbook entries.

Photograph file names will be in the format:

Photo #_WA_date

where:

WA indicates **<u>W</u>**oodstove **<u>A</u>**sh ABS Study
The date is formatted as MM-DD-YY

A digital video will be prepared to document a representative example of the ABS scenario and will include any special conditions or circumstances that arise during the activity. File names will be in the same format as photographic documentation listed above.

B3.2 Field Sample Custody

All teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss. All samples and FSDSs will be relinquished to the sample coordinator or designated secure sample storage area. The field team will be responsible for documenting this transfer of sample custody in the logbook.

B3.3 Chain-of-Custody Requirements

The chain-of-custody (COC) is used as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A complete COC record is required to accompany each shipment of samples. COC procedures will follow the requirements as stated in Site-specific SOP EPA-LIBBY-2012-06, *Sample Custody* (see **Appendix B**).

At the end of each day, all samples will be relinquished to the field sample coordinator or a designated secure storage location by the sampling team following COC procedures, and an entry will be made into the field logbook indicating the time samples were relinquished and the sample coordinator who received the samples. The field sample coordinator will follow COC procedures to ensure proper sample custody between acceptance of the sample from the field teams to delivery or shipment to the laboratory.

A member of the sample coordination staff will manually enter sample information from the hard copy FSDS into the local Scribe field project database using a series of standardized data entry forms developed in Microsoft Access by ESAT, referred to as the sample Data Entry Tool, or the "DE Tool". The DE Tool has a variety of built-in QC functions that improve accuracy of data entry and help maintain data integrity. After the data entry is checked against the hard copy FSDSs (by a different sample coordination staff member than completed the original data entry), the DE Tool is used to prepare an electronic COC. A three-page carbon copy COC will be generated from the electronic COC. The field sample coordinator will retain one hard copy of the COC for the project file; the other two hard copies of the COC will accompany the sample shipment.

The field sample coordinator will note the analytical priority level for the samples (based on consultation with the LC) at the top of the COC. A copy of the investigation-specific Analytical Requirements Summary Sheet (see **Appendix D**) will also accompany each COC.

If any errors are found on a COC after shipment, the hard copy of the COC retained by the field sample coordinator will be corrected with a single strikeout, initial, and date. A copy of the corrected COC will be provided to the LC for distribution to the appropriate laboratory. It is the responsibility of the field data manager to make any corrections to the local Scribe field project database. Sample and COC information will be published to Scribe.NET regularly from the local Scribe field project database by the field data manager (see Section B10.1 for additional details).

B3.4 Sample Packaging and Shipping

Samples will be packaged and shipped in general accordance with SOP EPA-LIBBY-2012-07, *Packaging and Shipping of Environmental Samples* (see **Appendix B**). In brief, a custody seal will be placed over at least two sides of the shipping cooler and then secured by tape. Prior to sealing the shipping container, the sample coordinator will perform a final check of the contents of the shipment with the COC, sign and date the designated spaces at the bottom of the COC. The field sample coordinator will then place the custody seals on the shipping container.

The field sample coordinator will be responsible for sending samples to the appropriate location, as specified by the LC. All samples will be hand-delivered to the Troy Sample Preparation Facility (SPF) for subsequent shipment to the appropriate analytical laboratory, or archive.

For hand-deliveries, samples will be packaged for transit such that they are contained and secure (i.e., will not be excessively jostled). Clean plastic totes with the lids secured or sample coolers may be used for this purpose. For samples requiring shipment, an established overnight delivery service provider (e.g., Federal Express) will be used.

B3.5 Holding Times

In general, there are no holding time requirements for asbestos. Because sample preparation (see Section B4.1) will include techniques to address any issues related to holding time for the media (i.e., ashing of tree bark samples will address the growth of organic material that may occur between sample collection and sample analysis), there are no holding time requirements for samples collected as part of this sampling program.

B3.6 Archival and Final Disposition

All samples and grids will be maintained in storage at the analytical laboratory unless otherwise directed by the EPA. When authorized by the EPA, the laboratory will be responsible for proper disposal of any remaining samples, sample containers, shipping containers, and packing materials in accordance with sound environmental practice, based on the sample analytical results. The laboratory will maintain proper records of waste disposal methods, and will have disposal company contracts on file for inspection.

B4. Analytical Methods

B4.1 Analytical Methods and Requirements

This section discusses the analytical methods and requirements for samples collected in support of the comparative exposure sampling program. This section includes detailed information on the analysis of ABS air, ash, and tree bark, as well as the data reporting requirements, sample holding times, and custody procedures.

An analytical requirements summary sheet (**ASHOU4-1012**), which details the specific preparation and analytical requirements associated with this sampling program, is provided in **Appendix D**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this sampling program prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC.

B4.1.1 ABS Air Samples

The DQOs (see **Appendix A**) provide detailed information on the sample preparation, analysis method, counting rules, and stopping rules for ABS air. Each of these analysis requirements is summarized below.

Sample Preparation

Two filters are collected during each ABS event – a high volume filter and a low volume filter. The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded (i.e., > 25% particulate loading on the filter), the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter. If the low volume filter is also deemed to be overloaded, an indirect preparation (with ashing) may be performed of the high volume filter in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08, *Indirect Preparation of Air and Dust Samples for Analysis by TEM* (see **Appendix B**). The filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method

Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications[4] LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

Counting Rules

Because of the high number of grid openings that are needed to achieve the target analytical sensitivity (see **Appendix A**), all ABS air samples will be examined using counting protocols for recording phase contrast microscopy-equivalent (PCME) structures only (per ISO 10312 Annex E). That is, filters will be examined at a magnification of about 5,000x, and all amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate selective area electron diffraction (SAED) patterns and energy dispersive x-ray analysis (EDXA) spectra, and having length > 5 micrometers (µm), width ≥ 0.25 µm, and aspect ratio ≥ 3:1, will be recorded on the Libby-specific TEM laboratory bench sheets and EDDs for the recording of air samples. If observed, chrysotile structures should be recorded using the same basic procedures.

Stopping Rules

Appendix A provides detailed information on the derivation of the stopping rules for ABS air field samples analyzed by TEM. The stopping rules are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity (0.0058 per cubic centimeter [cc^{-1}]) is achieved.
    b. 25 PCME LA structures have been observed.
    c. A total filter area of 10 mm^2 has been examined (this is approximately 1,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

For lot blanks and field blanks, the TEM analyst should examine an area of 1.0 mm^2 (approximately 100 grid openings).

---

[4] Copies of all Libby Laboratory Modifications are available in the Libby Lab eRoom.

B4.1.2 Perimeter Stationary Air

Sample Preparation

The laboratory should attempt to prepare each perimeter air filter for analysis using direct preparation methods. If the filter is deemed to be overloaded (i.e., particulate loading on the filter is > 25%), an indirect preparation (with ashing) may be performed in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08, *Indirect Preparation of Air and Dust Samples for Analysis by TEM* (see **Appendix B**). The filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method, Counting Rules, and Stopping Rules

6-hour Perimeter Air Samples

The analytical requirements for the 6-hour samples are modeled after the requirements specified for perimeter air samples collected as part of exterior removal actions (CDM Smith 2011). Grids will be examined by TEM in basic accordance with the recording procedures described in the Asbestos Hazard Emergency Response Act (AHERA) (EPA 1987), as modified by the most recent versions of Libby Laboratory Modifications LB-000029, LB-000031, LB-000067, and LB-000085. If observed, chrysotile structures should be recorded using the same basic procedures.

The analyst should examine a minimum of two grid openings from each of two grids. Grid opening examination should continue until an analytical sensitivity of 0.005 cc^{-1} has been achieved. If this sensitivity cannot be achieved in less than 100 grid openings (e.g., if the sample must be prepared indirectly and the resulting f-factor is less than 0.03), the analyst should contact the LC for specific direction on how to proceed.

The standard turnaround time for the 6-hour perimeter air sample results will be 24-hours, unless otherwise requested on the COC. Because of this rapid turn-around requirement, it is anticipated that these samples will likely need to be analyzed by the EMSL laboratory in Libby.

3-day Perimeter Air Samples

The analytical requirements for the 3-day samples are modeled after the requirements specified for perimeter air samples collected as part of the OU4 outdoor ambient air monitoring program (CDM Smith 2006). Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000055, LB-000066, LB-000067, and LB-000085. That is, filters will be examined at high magnification (~ 20,000x), and all amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 micrometers (µm) and aspect ratio ≥ 3:1, will be recorded on the Libby-specific TEM laboratory bench sheets and EDDs for the recording of air samples. If observed, chrysotile structures should be recorded using the same basic procedures.

The analyst should examine a minimum of two grid openings from each of two grids. Grid opening examination should continue until an analytical sensitivity of 0.00004 cc^{-1} has been achieved. If this sensitivity cannot be achieved in less than 100 grid openings (e.g., if the sample must be prepared indirectly), the analyst should contact the LC for specific direction on how to proceed.

B4.1.3 Health & Safety Monitoring Samples

The personal air samples collected for the ongoing health and safety monitoring will be analyzed in accordance with the *Response Action SAP* (CDM Smith 2011). In brief, air samples will be prepared and analyzed by PCM in accordance with NIOSH Method 7400, Issue 2 and the most recent version of Libby Laboratory Modification LB-000015.

B4.1.4 Tree Bark Samples

Sample Preparation

Tree bark samples will be prepared and analyzed in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix B**). In brief, each sample is dried and ashed, and the resulting ash residue is acidified, suspended in water, and filtered. A total of three replicate filters will be created for each tree bark sample using equal aliquots of the ash residue. Each filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-12. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 um and an aspect ratio (length: width) ≥ 3:1, will be recorded. If observed, chrysotile structures should be recorded using the same procedures.

Stopping Rules

The stopping rules for the TEM analysis of tree bark are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:

a. The target analytical sensitivity (100,000 per square centimeter [cm^{-2}]) is achieved.

b. 50 LA structures have been observed.

c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

The results for each tree bark analysis will be expressed in terms of LA structures per square centimeter (s/cm^2) of tree bark (i.e., a surface area loading).

B4.1.5 Ash Samples

Sample Preparation

Ash samples will be prepared and analyzed using procedures similar to those specified in SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix B**). In brief, an aliquot of the ash material will be acidified, suspended in water, and filtered. A total of three replicate filters will be created for each ash sample using additional aliquots of the ash residue. Each filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-11 and the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 um and an aspect ratio (length: width) ≥ 3:1, will be recorded. If observed, chrysotile structures should be recorded using the same procedures.

Stopping Rules

The stopping rules for the TEM analysis of ash materials are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:

   a. The target analytical sensitivity (1E+07 per gram, dry weight [g^{-1}]) is achieved.

   b. 50 LA structures have been observed.

c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

The results for each ash analysis will be expressed in terms of LA structures per gram of ash (s/g).

B4.1.6 Equipment Rinsate Water

Note: All equipment rinsate samples will be archived pending the results of the tree bark samples; EPA will provide direction if/when rinsate samples should be analyzed.

Sample Preparation

All equipment rinsate water samples (see Section B5.1.5) should be prepared for asbestos analysis in basic accordance with the techniques in EPA Method 100.2, as modified by Libby Laboratory Modification LB-000020A. In brief, all water samples will be prepared using an ozone/ultraviolet treatment that oxidizes organic matter that is present in the water or on the walls of the bottle, destroying the material that causes clumping and binding of asbestos structures. Following treatment, an aliquot of water (generally about 50 milliliters) will be filtered through a 25-millimeter diameter polycarbonate filter with a pore size of 0.1 µm with a mixed cellulose ester filter (0.45 µm pore size) used as a support filter.

Analysis Method

Approximately one quarter of the filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

Counting Rules

All structures with fibrous morphology, an x-ray diffraction pattern consistent with amphibole asbestos, a energy dispersive spectrum consistent with LA, length greater than or equal to 0.5 µm, and an aspect ratio (length:width) greater than or equal to 3:1 will be counted and recorded. If observed, chrysotile structures will be recorded, but chrysotile structure counting may stop after 25 structures have been recorded.

TEM Stopping Rules

The TEM stopping rules for equipment rinsate water samples from this investigation are specified below and were selected to be consistent with the analytical requirements specified in other water sampling efforts conducted at the Site. The stopping rules are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. The target analytical sensitivity of 50,000 L^{-1} has been achieved.
   b. 25 LA structures have been observed.
   c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

B4.2 Analytical Data Reports

An analytical data report will be prepared by the laboratory and submitted to the appropriate LC after the completion of all required analyses within a specific laboratory job (or sample delivery group). This analytical data report may vary by laboratory and analytical method but generally includes a case narrative that briefly describes the number of samples, the analyses, and any analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include copies of the signed COC forms, analytical data summaries, a QC package, and raw data. Raw data is to consist of instrument preparation logs, instrument printouts, and QC sample results including, instrument maintenance records, COC check in and tracking, raw data instrument print outs of sample results, analysis run logs, and sample preparation logs. The laboratory will provide an electronic scanned copy of the analytical data report to the LC and others, as directed by the LC.

B4.3 Laboratory Data Reporting Tools

Standardized data reporting tools (i.e., EDDs) have been developed specifically for the Libby project to ensure consistency between different laboratories in the presentation and submittal of analytical data. In general, unique Libby-specific EDDs have been developed for each analytical method and each medium. Since the beginning of the Libby project, each EDD has undergone continued development and refinement to better accommodate current and anticipated future data needs and requirements. EDD refinement continues based on laboratory and data user input. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom.

For TEM analyses, detailed raw structure data will be recorded and results will be transmitted using the Libby-specific EDDs for TEM. For PLM analyses, optical property details and results will be recorded on the Libby-specific EDDs for PLM. Standard project data reporting requirements will be met for TEM and PLM analyses. EDDs will be transmitted electronically (*via* email) to the following:

- Doug Kent, Kent.Doug@epa.gov
- Janelle Lohman, Lohman.Janelle@epa.gov
- Holly Sprunger, Sprunger.Holly@epa.gov
- Tracy Dodge, DodgeTA@cdmsmith.com
- Phyllis Haugen, HaugenPJ@cdmsmith.com
- Libby project email address for CDM Smith, libby@cdmsmith.com

Note: ESAT is in the process of developing a new Site-specific analytical results reporting tool, referred to as the Libby Asbestos Data Tool (LADT). This tool is a relational Microsoft® Access database with a series of standard data entry forms specific to each analytical method. The LADT creates a Microsoft® Excel export file that can be directly uploaded into an analytical Scribe project database (see Section B10.4). Laboratories have the option of using LADT as a data reporting method instead of the Libby-specific EDDs.

B4.4 Analytical Turn-around Time

Analytical turn-around time will be negotiated between the EPA LC and the laboratory. It is anticipated that, with the exception of the 6-hour perimeter air samples, turn-around times of 2-4 weeks are acceptable, but this may be revised as determined necessary by the EPA. For the 6-hour perimeter air samples, a 24-hour turn-around time is required.

B4.5 Custody Procedures

Specific laboratory custody procedures are provided in each laboratory's *Quality Assurance Management Plan*, which have been independently reviewed at the time of laboratory procurement. While specific laboratory sample custody procedures may differ between laboratories, the basic laboratory sample custody process is described briefly below.

Upon receipt at the facility, each sample shipment will be inspected to assess the condition of the shipment and the individual samples. This inspection will include verifying sample integrity. The accompanying COC will be cross-referenced with all of the samples in the shipment. The laboratory sample coordinator will sign the COC and maintain a copy for their project files.

Depending upon the laboratory-specific tracking procedures, the laboratory sample coordinator may assign a unique laboratory identification number to each sample on the COC. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the responsibility of the laboratory manager to ensure that internal logbooks and records are maintained throughout sample preparation, analysis, and data reporting.

B5. Quality Assurance/Quality Control

B5.1 Field

Field QA/QC activities include all processes and procedures that have been designed to ensure that field samples are collected and documented properly, and that any issues/deficiencies associated with field data collection or sample processing are quickly identified and rectified. The following sections describe each of the components of the field QA/QC program implemented at the Site.

B5.1.1 Training

Before performing field work in Libby, field personnel are required to read all governing field guidance documents relevant to the work being performed and attend a field planning meeting specific to the Comparative Exposure sampling effort. Additional information on field training requirements is provided in Section A8.1.

B5.1.2 Modification Documentation

All field deviations from and modifications to this SAP/QAPP will be recorded on the Libby field ROM form[5]. The field ROM forms will be used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation work that have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) will be documented in the field logbooks. ROMs are completed by the FTL overseeing the investigation/activity, or by assigned field or technical staff. As modifications to governing documents are implemented, the FTL will communicate the changes to the field teams conducting activities associated with the modification.

Each completed field ROM is assigned a unique sequential number (e.g., LFO-000026) by the CDM Smith field QAM. A ROM tracking log for all field modifications is maintained by the field QAM. This tracking log briefly describes the ROM being documented, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the appropriate EPA RPM for review and approval. Copies of approved ROMs are maintained on the CDM Smith server in Libby.

B5.1.3 Field Surveillances

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. It is not anticipated that a field surveillance will be performed for this investigation. However, field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

[5] The most recent version of the field ROM form is available in the Libby Field eRoom.

B5.1.4 Field Audits

Field audits are broader in scope than field surveillances. Audits are evaluations conducted by qualified technical or QA staff that are independent of the activities audited. Field audits can be conducted by field contractors, internal EPA staff, or EPA contracted auditors. It is the responsibility of the EPA RPM to ensure that field auditing requirements are met for each investigation. Because this sampling design is unique to other sampling efforts that have occurred in the past at the site, one field audit will be conducted during the early stages of this investigation to identify any early deficiencies so that any impact on project data quality is limited.

B5.1.5 Field QC Samples

Field QC samples are collected to help ensure that field samples are not contaminated from exogenous sources during sample collection, and to help evaluate the precision of field sample analytical results. Field QC samples are assigned unique field identifiers and are submitted to the analytical laboratory along with the associated field samples.

Air

Two types of field QC samples will be collected as part of the air sampling portion of this study – lot blanks and field blanks.

<u>Lot Blank</u>

Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. A lot blank is a randomly selected filter cassette from a manufactured lot. One lot blank is required for every 500 cassettes. It is the responsibility of the FTL to submit the appropriate number of lot blanks prior to cassette use in the field. The lot blanks are analyzed for asbestos by TEM analysis as described above (see Section 5.1.3). Lot blank results will be reviewed by the FTL before any cassette in the lot is used for sample collection. The entire batch of cassettes will be rejected if any asbestos is detected on either lot blank. Only filter lots with acceptable lot blank results are placed into use for this study.

<u>Field Blank</u>

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For this sampling effort, field blanks will be collected at a rate of 1 per field team per air sampling day, as illustrated in **Figure B-2** (i.e., a total of six field blanks). It is the responsibility of each field team to collect the appropriate number of field blanks. Field blanks are collected by removing the end cap of the sample cassette to expose the filter in the same area where sample collection occurs for about 30 seconds before re-capping the sample cassette. Two field blanks, chosen at random by the sample coordinator, will be analyzed. The field blanks are analyzed for asbestos by TEM analysis as described above (see Section 5.1.3).

If any asbestos is observed on a field blank, all other field blanks collected by that field team will be submitted for analysis to determine the potential impact on the related sample results. The FTL and/or laboratory manager will be notified and will take appropriate measures (e.g., re-training on sample collection and analysis procedures) to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected.

Tree Bark

Two types of field QC samples may be collected as part of the tree bark sampling portion of this program – equipment rinsates (if necessary) and field duplicates. Field blanks for tree bark are not required for this sampling program.

Equipment Rinsates

Equipment rinsates are collected to evaluate potential contamination that arises to due inadequate decontamination of tree bark sampling equipment. *Equipment rinsates will only be collected if non-dedicated tree bark field sampling equipment (i.e., hole saws, chisels) are utilized.* Following decontamination efforts, the decontaminated equipment (i.e., hole saw, chisel) should be rinsed with clean water (e.g., store-bought drinking water), and the resulting rinsate should be collected in a high density polyethylene (HDPE) container. One equipment rinsate blank should be collected per team per day. It is the responsibility of each field team to collect the appropriate number of equipment rinsate blanks. Equipment rinsate blanks should be labeled with a unique sample number and submitted for analysis by TEM.

If any asbestos structures are observed on an equipment rinsate, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "EB" will be added to the related field sample results in the project database to denote that the associated equipment rinsates had asbestos structures detected.

Field Duplicates

One field duplicate sample of tree bark will be collected as part of this sampling program. Field duplicates for tree bark will be collected in close proximity to (within 6 inches) of the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given unique sample number, and field personnel will record the sample number of the associated collocated sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

Ash

No field QC samples are required for ash.

B5.2 Analytical Laboratory

Laboratory QA/QC activities include all processes and procedures that have been designed to ensure that data generated by an analytical laboratory are of high quality and that any problems in sample preparation or analysis that may occur are quickly identified and rectified. The following sections describe each of the components of the analytical laboratory QA/QC program implemented at the Site.

B5.2.1 Training/Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Additional information on laboratory training and certification requirements is provided in Section A8.2.

Laboratories handling samples collected as part of this sampling program will be provided a copy of and will adhere to the requirements of this SAP/QAPP. Samples collected under this SAP/QAPP will be analyzed in accordance with standard EPA and/or nationally-recognized analytical procedures (i.e., Good Laboratory Practices) in order to provide analytical data of known quality and consistency.

B5.2.2 Modification Documentation

All deviations from project-specific and method guidance documents will be recorded on the laboratory ROM form[6]. The ROM will be used to document all permanent and temporary changes to analytical procedures. ROMs will be completed by the appropriate laboratory or

[6] The most recent version of the laboratory ROM form is available in the Libby Lab eRoom.

technical staff. As ROMs are completed, it is the responsibility of the LC to communicate any changes to the project laboratories. When the project management team determines the need, this SAP/QAPP will be revised to incorporate necessary modifications.

Copies of approved ROMs for this SAP/QAPP will be made available in the Libby Lab eRoom.

B5.2.3 Laboratory Audits

Each laboratory working on the Libby project is required to participate in an annual on-site laboratory audit carried out by the EPA through the QATS contract. These audits are performed by EPA personnel (and their contractors), that are external to and independent of, the Libby laboratory team members. These audits ensure that each analytical laboratory meets the basic capability and quality standards associated with analytical methods for asbestos used at the Libby site. They also provide information on the availability of sufficient laboratory capacity to meet potential testing needs associated with the Site.

External Audits

Audits consist of several days of technical and evidentiary review of each laboratory. The technical portion of the audit involves an evaluation of laboratory practices and procedures associated with the preparation and analysis of samples for the identification of asbestos. The evidentiary portion of the audit involves an evaluation of data packages, record keeping, SOPs, and the laboratory *QA Management Plan*. A checklist of method-specific requirements for the commonly used methods for asbestos analysis is prepared by the auditor prior to the audit, and used during the on-site laboratory evaluation.

Evaluation of the capability for a laboratory to analyze a sample by a specific method is made by observing analysts performing actual sample analyses and interviewing each analyst responsible for the analyses. Observations and responses to questions concerning items on each method-specific checklist are noted. The determination as to whether the laboratory has the capability to analyze a sample by a specific method depends on how well the analysts follow the protocols detailed in the formal method, how well the analysts follow the laboratory-specific method SOPs, and how the analysts respond to method-specific questions.

Evaluation of the laboratory to be sufficient in the evidentiary aspect of the audit is made by reviewing laboratory documentation and interviewing laboratory personnel responsible for maintaining laboratory documentation. This includes personnel responsible for sample check-in, data review, QA procedures, document control, and record archiving. Certain analysts responsible for method quality control, instrument calibration, and document control are also interviewed in this aspect of the audit. Determination as to the capability to be sufficient in this aspect is made based on staff responses to questions and a review of archived data packages and QC documents.

It is the responsibility of the QATS contractor to prepare an On-site Audit Report for each analytical laboratory participating in the Libby program. These reports are handled as business confidential items. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each laboratory to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an On-Site Audit Trend Analysis Report on an annual basis. This report shall include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this reported is to identify common asbestos laboratory performance problems and isolate the potential causes.

Internal Audits

Each laboratory will also conduct periodic internal audits of their specific operations. Details on these internal audits are provided in the laboratory *QA Management Plan*. The laboratory QAM should immediately contact the LC and the QATS contractor if any issues are identified during internal audits that may impact data quality.

B5.2.4 Laboratory QC Analyses

General Requirements

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by NVLAP. In brief, there are three types of laboratory-based QC analyses for TEM – laboratory blanks, recounts, and repreparations. Detailed information on the Libby-specific requirements for each type of TEM QC analysis, including the minimum frequency rates, selection procedures, acceptance criteria, and corrective actions are provided in the most recent version of Libby Laboratory Modification LB-000029.

With the exception of inter-laboratory analyses, it is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed. Inter-laboratory analyses for TEM will be selected *post hoc* by the QATS contractor (or their designee) in accordance with the selection procedures presented in LB-000029. The LC will provide the list of selected inter-laboratory analyses to the laboratory manager and will facilitate the exchange of samples between the analytical laboratories.

Tree Bark-Specific Requirements

In addition to the laboratory-based QC analyses discussed above, TEM analyses of tree bark have additional QC analyses that are required, including drying blanks and filtration blanks. Because three replicate filters will be prepared and analyzed for each tree bark sample, no laboratory duplicate analyses will be required for this sampling effort. Detailed information on the Libby-specific requirements for each type of TEM QC analysis is provided in the medium-specific SOPs (i.e., EPA-LIBBY-2012-12). It is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed.

B6/B7. Instrument Maintenance and Calibration

B6/B7.1 Field Equipment

B6/B7.1.1 General Maintenance

All field equipment (e.g., wood moisture meter, GPS units) should be maintained in basic accordance with manufacturer specifications. When a piece of equipment is found to be operating incorrectly, the piece of equipment will be labeled "out of order" and placed in a separate area from the rest of the sampling equipment. The person who identified the equipment as "out of order" will notify the FTL overseeing the investigation activities. It is the responsibility of the FLT to facilitate repair of the out-of-order equipment. This may include having appropriately trained field team members complete the repair or shipping the malfunctioning equipment to the manufacturer. Field team members will have access to basic tools required to make field acceptable repairs. This will ensure timely repair of any "out of order" equipment.

B6/B7.1.2 Air Pump Calibration

Air sampling pumps will be calibrated at the start of each day's sampling period using a rotameter that has been calibrated to a primary calibration source. The primary calibration standard used at the Site is a Bios DryCal® DC-Lite. For pre-sampling purposes, calibration will be considered complete when ± 5% of the desired flow rate is attained, as determined by three measurements with the calibrator using a cassette reserved for calibration (from the same lot as the sample cassettes to be used in the field). Additional calibration may be performed during sample collection as described below.

If at any time the observed flow rates are ± 10% of the target rate, the sampling pump should be re-calibrated, if possible. If at any time an air sampling pump is found to have faulted or the observed flow rates are 25% below (due to heavy particulate loading or a pump malfunction) or 50% above the target rate, the pump will be replaced or the activity will be terminated. Collection of air samples will continue, regardless of the amount of particulate loading on the filters, unless the flow rate is affected. At the beginning of the sampling program, flow rates and particulate loading may be checked more frequently as conditions require, establishing expected conditions.

To calculate the percentage of an observed flow to the target flow, the following formula is used:

$$X\% = \frac{Observed\ Flow\ Rate\ (L/min)}{Target\ Flow\ Rate\ (L/min)} \cdot 100$$

For post-sampling calibration, three separate constant flow calibration readings will be obtained with the sampling cassette inline and those flow readings will be averaged. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-sampling rates will be used to calculate the total sample volume.

Samples for which there is more than a 30% difference from initial calibration to end calibration will be invalidated. The sample collector will record the pump serial number, sample number, initial flow rate, sample start/end times, sample locations, and final flow rate, as well as mark the sample "void," in the field logbook and FSDS. These samples will not be submitted for analysis.

To prevent potential cross-contamination, each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. The cap and calibration cassette used at the end of the rotameter tubing will be replaced each day after it is used.

B6/B7.2 Laboratory Instruments

All laboratory instruments used for this project will be maintained and calibrated in accordance with the manufacturer's instructions. If any deficiencies in instrument function are identified, all analyses shall be halted until the deficiency is corrected. The laboratory shall maintain a log that documents all routine maintenance and calibration activities, as well as any significant repair events, including documentation that the deficiency has been corrected.

B8. Inspection/Acceptance of Supplies and Consumables

B8.1 Field

In advance of field activities, the FTL will check the field equipment/supply inventory and procure any additional equipment and supplies that are needed. The FTL will also ensure any in-house measurement and test equipment used to collect data/samples as part of this SAP/QAPP is in good, working order, and any procured equipment is acceptance tested prior to use. Any items that the FTL determines unacceptable will be removed from inventory and repaired or replaced as necessary.

The following list summarizes the general equipment and supplies required for most investigations:

- Field logbook – Used to document field sampling activities and any problems in sample collection or deviations from the investigation-specific QAPPs. See Section B3.1.3 for standard procedures for field logbooks.

- Field sample data sheets (FSDSs) – FSDSs forms that are used to document sample details (i.e., sampling location, sample number, medium, field QC type, etc.). See Section B3.1.2 for standard procedures for the completion of FSDSs.

- Sample number labels – Sample numbers are sequential numbers with investigation-specific prefixes. Sample number labels are pre-printed and checked out to the field teams by the FTL (or their designee). To avoid potential transcription errors in the field, multiple labels of the same sample number are prepared – one label is affixed to the collected sample, one label is affixed to the hard copy FSDS form. Labels may also be affixed to the field logbook.

- COC forms and custody seals – COCs are project-specific forms that are used to document sample custody from field collection through analysis reporting. See Section B3.3 for standard procedures for the completion of COC forms.

- Indelible ink pen, permanent marker – Indelible ink pens are used to complete required manual data entry of information on the FSDS and in the field logbook (pencil may not be used). Permanent markers may also be used to write sample numbers on the sample containers.

- Personal protective equipment (PPE) - As required by the HASP.

- Land survey map or aerial photo – Used to identify appropriate sampling locations. In some cases, sketches may be added to the map/photo to designate sampling and visual inspection locations and other Site features.

- Digital camera – Used to document sampling locations and conditions. See Section B3.1.4 for standard procedures in photographic documentation.

- GPS unit – Used to identify and mark sampling locations. See B2.2 for standard procedures in GPS documentation.

- Plastic zip-top bags – Zip-top bags are used as sample containers for most types of environmental samples. Sample number labels will be affixed to the bags or the sample number will be hand-written in permanent marker on the bags.

- Decontamination equipment – Used to remove any residual asbestos contamination on reusable sampling equipment between the collection of samples. See Section B2.3 for standard decontamination procedures.

In addition to the generic equipment list, the following equipment will be required for sampling activities as part of this program:

- ABS air sampling equipment: 25-millimeter (mm) diameter mixed cellulose ester filter cassette (0.8 µm pore), high and low flow rate battery-powered air sampling pumps, rotameter, tygon tubing, rotameter, tygon tubing, belt or backpack to attach pumps to sampler

- Stationary air monitoring equipment: telescoping tri-pond stand

- Tree bark sampling equipment: aerosol hairspray, battery-powered drill, 2-inch diameter hole saw, chisel

- Three EPA-certified wood-burning stoves for residential use

- Wood moisture meter to measure moisture content of the firewood prior to burning

- Woodstove temperature gauges

- Three sets of ash removal tools and supplies

- Temporary enclosure supplies: support posts, polyvinyl sheeting, duct tape, etc.

B8.2 Laboratory

The laboratory manager is responsible for ensuring that all reagents and disposable equipment used in this project is free of asbestos contamination. This is demonstrated by the collection of blank samples, as described in Section B5.

B9. Non-direct Measurements

There are no non-direct measurements that are anticipated for use in this project.

B10. Data Management

The following subsections describe the field and analytical laboratory data management procedures and requirements for this investigation. These subsections also describe the project databases utilized to manage and report data from this investigation. Detailed information regarding data management procedures and requirements can be found in the *EPA Data Management Plan* for the Libby Asbestos Superfund Site (EPA 2012).

B10.1 Field Data Management

Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Data for the Site are captured in various Scribe projects. Additional information regarding Scribe and the Libby Scribe project databases is discussed in Section B10.3.

The field data manager utilizes a "local" field Scribe project database (i.e., LibbyCDM_Field.mdb) to maintain field sample information. The term "local" denotes that the database resides on the server or personal computer of the entity that is responsible for the creating/managing the database. It is the responsibility of the field data manager to ensure that all local field Scribe project databases are backed-up nightly to a local server.

Field sample information from the FSDS is manually entered by a member of the field sample coordination staff using a series of standardized data entry forms (i.e., DE Tool). This tool is a Microsoft Access database that was originally developed by ESAT. The DE Tool is currently maintained by CDM Smith and resides on the local server in the Libby field office. This tool is used to prepare an electronic COC. Data in the DE Tool are imported into the local field Scribe project database by the field data manager.

It is the responsibility of the field data manager to "publish" sample and COC information from the local field Scribe database to Scribe.NET on a daily basis. It is not until a database has been published via Scribe.NET that it becomes available to external users.

B10.2 Analytical Laboratory Data Management

The analytical laboratories utilize several standardized data reporting tools developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique Libby-specific EDD has been developed for each analytical method and each sampling medium. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom.

Once the analytical laboratory has populated the EDD with results, the spreadsheet(s) are transmitted via email to the ESAT TEM Laboratory Manager, the ESAT project data manager, and the FTL (or their designee). (Other email recipients may also be specified by the ESAT LC).

The ESAT project database manager utilizes a local analytical Scribe project database (i.e., LibbyLab2012.mdb) to maintain analytical results information. The EDDs are uploaded directly into the analytical Scribe project database. It is the responsibility of the ESAT project data manager to publish analytical results information from the local analytical Scribe database to Scribe.NET.

B10.3 Libby Project Database

As noted above, Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Multiple Scribe projects can be stored and shared through Scribe.NET, which is a web-based portal that allows multiple data users controlled access to Scribe projects. Local Scribe projects are "published" to Scribe.NET by the entity responsible for managing the local Scribe project. External data users may "subscribe" to the published Scribe projects via Scribe.NET to access data. Subscription requests are managed by ERT.

All data collected for this investigation will be maintained in Scribe. As discussed above, data will be are captured in various Scribe project databases, including a field Scribe project (i.e., LibbyCDM_Field.mdb) and an analytical results Scribe project (i.e., LibbyLab2012.mdb).

B10.4 Data Reporting

Data users can access data for the Libby project through Scribe.NET. To access data, a data user must first download the Scribe application from the EPA ERT website[7]. The data user must then subscribe to each of the published Scribe projects for the Site using login and password information that are specific to each individual Scribe project. Scribe subscriptions for the Libby project are managed by ERT. Using the Scribe application, a data user may download a copy of any published Scribe project database to their local hard drive. It is the responsibility of the data user to regularly update their local copies of the Libby Scribe projects via Scribe.NET.

The Scribe application provides several standard queries that can be used to summarize and view results within an individual Scribe project. However, these standard Scribe queries cannot be used to summarize results across multiple Scribe projects (e.g., it is not possible to query both the "LibbyCDM_Field" project and the "LibbyLab2012" project using these standard Scribe queries).

If data users wish to summarize results across multiple published Scribe projects, there are two potential options. Data users may request the development of a "combined" project from ERT. This combined project compiles tables from multiple published Scribe projects into a single Scribe project. This allows data users to utilize the standard Scribe queries to summarize and view results.

Alternatively, data users may download copies of multiple published Scribe project databases for the Site and utilize Microsoft Access to create user-defined queries to extract the desired data across Scribe projects. This requires that the data user is proficient in Microsoft Access and has an intimate knowledge of proper querying methods for asbestos data for the Site.

[7] http://www.ertsupport.org/scribe_home.htm

It is the responsibility of the data users to perform a review of results generated by any data queries and standard reports to ensure that they are accurate, complete, and representative. If issues are identified by the data user, they should be reported to the EPA Region 8 data manager for resolution via email (Mosal.Jeffrey@epa.gov). It is the responsibility of the EPA Region 8 data manager to notify the appropriate entity (e.g., field, Troy SPF, analytical laboratory) in order to rectify the issue. A follow-up email will be sent to the party reporting the issue to serve as confirmation that a resolution has been reached and any necessary changes have been made.

C ASSESSMENT AND OVERSIGHT

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities.

C1. Assessment and Response Actions

C1.1 Assessments

System assessments are qualitative reviews of different aspects of project work to check the use of appropriate QC measures and the general function of the QA system. Field and office system assessments will be performed under the direction of CDM Smith's QA Director, with support from the CDM Smith QA Manager. As noted previously, it is anticipated that a field audit will be performed during this sampling program. The field audit findings will be documented in an audit report. A copy of the report will be provided to the EPA RPM and the QATS contractor. Field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

System assessments/audits of the Troy SPF and analytical laboratories will be conducted by the QATS contractor, as coordinated by the EPA.

C1.2 Response Actions

Corrective response actions will be implemented on a case-by-case basis to address quality problems. Minor actions taken to immediately correct a quality problem will be documented via logbook and reported to the appropriate manager (e.g., the FTL or EPA LC). Major corrective actions (i.e., those that impact or have the potential to impact investigation objectives) will be approved by the EPA RPM and the appropriate manager prior to implementation. Major corrective actions will be documented via a ROM form. EPA project management will be notified when quality problems arise that cannot be corrected quickly through routine procedures.

C2. Reports to Management

No regularly-scheduled written reports to management are planned as part of this sampling program. However, QA reports may be provided to management for routine audits and whenever significant quality problems are encountered.

D DATA VALIDATION AND USABILITY

D1. Data Review, Verification and Validation

D1.1 Data Review

Data review of Scribe project data typically occurs at the time of data reporting by the data users and includes cross-checking that sample IDs and sample dates have been reported correctly and that calculated analytical sensitivities or reported values are as expected. If discrepancies are found, the data user will contact the EPA database administrator, who will then notify the appropriate entity (field, preparation facility, or laboratory) in order to correct the issue.

D1.2 Criteria for LA Measurement Acceptability

Several factors are considered in determining the acceptability of LA measurements in samples analyzed by TEM. This includes the following:

1. *Evenness of filter loading.* This is evaluated using a chi-squared (CHISQ) test, as described in ISO 10312 Annex F2. If a filter fails the CHISQ test for evenness, the result may not be representative of the true concentration in the sample, and the result should be given low confidence.

2. *Results of QC samples.* This includes both field and laboratory QC samples, such as field and laboratory blank samples, as well as various types of recount and re-preparation analyses. If significant LA contamination is detected in field or laboratory blanks, all samples prepared on that day should be considered to be potentially biased high. If agreement between original analyses and field or laboratory duplicates (i.e., repreparation or recount analyses) is poor, results for those samples should be given low confidence.

D2. Verification and Validation Methods

D2.1 Data Verification

Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy field and analytical laboratory documentation to the project databases. The goal of data verification is to identify and correct data reporting errors.

For analytical laboratories that utilize the Libby-specific EDD spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. In addition to these automated checks, a detailed manual data verification effort will be performed for 10% of all samples and TEM analytical results collected as part of this sampling effort. This data verification process utilizes Site-specific SOPs (see **Appendix B**) developed to ensure TEM results and field sample information in the project databases is accurate and reliable:

- EPA-LIBBY-09 – SOP for TEM Data Review and Data Entry Verification – This Site-specific SOP describes the steps for the verification of TEM analyses, based on a review of the laboratory benchsheets, and verification of the transfer of results from the benchsheets into the project database.

- EPA-LIBBY-11 - SOP for FSDS Data Review and Data Entry Verification – This Site-specific SOP describes the steps for the verification of field sample information, based on a review of the FSDS form, and verification of the transfer of results from the FSDS forms into the project database. An FSDS review is performed on all samples selected for TEM or PLM data verification.

The data verification review ensure that any data reporting issues are identified and rectified to limit any impact on overall data quality. If issues are identified during the data verification, the frequency of these checks may be increased as appropriate.

Data verification will be performed by appropriate technical staff that is familiar with project-specific data reporting, analytical methods, and investigation requirements. The data verifier will prepare a data verification report (template reports are included in the SOPs) to summarize any issues identified and necessary corrections. A copy of this report will be provided to the appropriate project data manager, LC, and the EPA RPM. The data verifier will also transmit the results of the data verification, including any electronic files summarizing identified discrepancies, via email to the EPA Region 8 data manager (Mosal.Jeffrey@epa.gov) for resolution. A follow-up email will be sent to the data verifier to serve as confirmation that a resolution has been reached on any issues identified.

It is the responsibility of the EPA Region 8 data manager to coordinate with the FTL and/or LC to resolve any project database corrections and address any recommended field or laboratory procedural changes from the data verifier. The EPA Region 8 data manager is also responsible for electronically tracking in the project database which data have been verified, who performed the verification, and when.

D2.2 Data Validation

Unlike data verification, where the goal is to identify and correct data reporting errors, the goal of data validation is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to any potential data quality issues. Data validation will be performed by the QATS contractor (or their designee), with support from technical support staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements.

Data validation for asbestos should be performed in basic accordance with the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011b), and should include an assessment of the following:

- Internal and external field audit/surveillance reports
- Field ROMs
- Field QC sample results
- Internal and external laboratory audit reports
- Laboratory contamination monitoring results
- Laboratory ROMs
- Internal laboratory QC analysis results
- Inter-laboratory analysis results
- Performance evaluation results
- Instrument checks and calibration results
- Data verification results (i.e., in the event that the verification effort identifies a larger data quality issue)

A comprehensive data validation effort should be completed quarterly and results should be reported as a technical memorandum. This technical memorandum shall detail the validation procedures performed and provide a narrative on the quality assessment for each type of asbestos analysis, including the data qualifiers assigned, and the reason(s) for these qualifiers. The technical memorandum shall detail any deficiencies and required corrective actions.

The QATS contractor will also prepare an annual addendum to the *Quality Assurance and Quality Control Summary Report for the Libby Asbestos Superfund Site* (CDM Smith 2011) to summarize results of the quarterly data validation efforts. This addendum should include a summary of any data qualifiers that are to be added to the project database to denote when results do not meet NFG guidelines and/or project-specific acceptance criteria. This addendum should also include recommendations for Site QA/QC program changes to address any data quality issues.

The data validator will transmit the results for each data validation effort via email to the EPA Region 8 data manager (Mosal.Jeffrey@epa.gov). This email should include an electronic summary of the records that have been validated, the date they were validated, any recommended data qualifiers, and their associated reason codes. It is the responsibility of the EPA Region 8 data manager to ensure that the appropriate data qualifiers and reason codes recommended by the data validator are added to the project database, and to electronically track in the project database which data have been validated, who performed the validation, and when.

In addition to performing quarterly data validation efforts, it is the responsibility of the QATS contractor (or their designee) to perform regular evaluations of all field blanks and SPF preparation blanks, to ensure that any potential contamination issues are quickly identified and resolved. If any blank contamination is noted, the QATS contractor should immediately contact the appropriate field QAM or SPF QAM to ensure that corrective actions are made.

D3. Reconciliation with User Requirements

It is the responsibility of data users to perform a data usability assessment to ensure that DQOs have been met, and reported investigation results are adequate and appropriate for their intended use. This data usability assessment should utilize results of the data verification and data validation efforts to provide information on overall data quality specific to each investigation.

The data usability assessment should evaluate results with regard to several data usability indicators. **Table D-1** summarizes several indicators of data usability and presents general evaluation methods for each indicator. Depending upon the nature of the investigation, other evaluation methods may also be appropriate. The data usability assessment results and conclusions should be included in any investigation-specific data summary reports.

Non-attainment of project requirements may result in additional sample collection or field observations in order to achieve project needs.

Table D-1: General Evaluation Methods for Assessing Asbestos Data Usability

Data Usability Indicator	General Evaluation Method
Precision	Sampling – Review results for co-located samples and field duplicates to provide information on variability arising from medium spatial heterogeneity and sampling and analysis methods. Analysis – Review results for TEM laboratory duplicates, filter replicates, recounts, and repreparations to provide information on variability arising from analysis methods. Review results for inter-laboratory analyses to provide information on variability and potential bias between laboratories.
Accuracy/Bias	Calculate the background filter loading rate and use results to assign detect/non-detect in basic accordance with ASTM 6620-00. For air samples, determine the frequency of indirect preparation.
Representativeness	Review relevant field audit report findings and any field/laboratory ROMs for potential data quality issues.
Comparability	Compare the sample collection SOPs, preparation techniques, and analysis methods to previous investigations.
Completeness	Determine the percent of samples that were able to be successfully collected and analyzed (e.g., 99 of 100 samples, 99%).
Sensitivity	Determine the fraction of all analyses that stopped based on the area examined stopping rule (i.e., did not achieve the target sensitivity).

% = percent
ASTM = American Society of Testing and Materials
ROM = record of modification
SOP = standard operating procedure
TEM = transmission electron microscopy

References

Amandus, H.E., and Wheeler, R. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part II Mortality. *American Journal of Industrial Medicine* 11:15-26.

Amandus, H.E., Wheeler, P.E., Jankovic, J., and Tucker, J. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part I Exposure Estimates. *American Journal of Industrial Medicine.* 11:1-14.

CDM Smith. 2006. Sampling and Analysis Plan for Outdoor Ambient Air Monitoring at the Libby Asbestos Site, Operable Unit 4, Libby, Montana. Revision 1, December.

____. 2011. Response Action Sampling and Analysis Plan, Revision 2. June.

____. 2012a. Sampling and Analysis Plan/Quality Assurance Project Plan: Commercial Logging ABS Study, Operable Unit 3, Libby Asbestos Superfund Site, Libby, Montana. Revision 0 – August 2012.

____. 2012b. Sampling and Analysis Plan/Quality Assurance Project Plan: Opportunistic Commercial Logging Sampling, Upper Flower Creek Timber Unit 16. Revision 0 – November 2012.

____. 2012c. Sampling and Analysis Plan/Quality Assurance Project Plan: Nature & Extent of LA Contamination in the Forest Study, Operable Unit 4, Libby Asbestos Superfund Site, Libby, Montana. Revision 0 – August 2012.

EPA. 2001. *EPA Requirements for Quality Assurance Project Plans – EPA QA/R-5*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-01/003. March. http://www.epa.gov/quality/qs-docs/r5-final.pdf

_____. 2003. Technical Memorandum: Libby Asbestos Site Residential/Commercial Cleanup Action Level and Clearance Criteria. U.S. Environmental Protection Agency, Region 8. Draft Final – December 15, 2003.

____. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-06/001. February. http://www.epa.gov/quality/qs-docs/g4-final.pdf

_____. 2008a. Performance Evaluation of Laboratory Methods for the Analysis of Asbestos in Soil at the Libby, Montana Superfund Site. Produced by Syracuse Research Corporation for EPA, Region 8. Draft – October 7, 2008.

_____. 2008b. Characteristic EDS Spectra for Libby-Type Amphiboles. Produced by Syracuse Research Corporation for EPA, Region 8. Final – March 18, 2008.

____. 2011a. Remedial Investigation for Operable Unit 3, Libby Asbestos Superfund Site, Quality Assurance Project Plan, Estimation of Asbestos Levels in Smoke Using a Burn Chamber. September.

____. 2011b. *National Functional Guidelines for Asbestos Data Review.* U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. Draft – August 2011.

____. 2012. *EPA Data Management Plan for the Libby Asbestos Superfund Site*. Draft - 2012.

McDonald, J.C., McDonald, A.D., Armstrong, B., and Sebastien, P. 1986. Cohort Study of Mortality of Vermiculite Miners Exposed to Tremolite. *British Journal of Industrial Medicine* 43:436-444.

Nelson, W. 1982. *Applied Life Data Analysis*. John Wiley & Sons, New York. pp 438-446.

Peipins, L.A., Lewin, M., Campolucci, S., Lybarger, J.A., Kapil, V., Middleton, D., Miller, A., Weis, C., Spence, M., and Black, B., 2003. Radiographic Abnormalities and Exposure to Asbestos-Contaminated Vermiculite in the Community of Libby, Montana, USA. *Environmental Health Perspectives* 111:1753-1759.

Sullivan, P.A. 2007. Vermiculite, Respiratory Disease and Asbestos Exposure in Libby, Montana: Update of a Cohort Mortality Study. *Environmental Health Perspectives* 115(4):579-585.

Ward, T.J., J.F. Hart, T.M. Spear, B.J. Meyer, and J.S. Webber. 2009. Fate of Libby Amphibole Fibers When Burning Contaminated Firewood. *Environ Sci Technol.* 43(8): 2878–2883.

Sampling and Analysis Plan/Quality Assurance Project Plan: Wood-Burning Stove Ash Removal Activity-Based Sampling Libby Asbestos Site, Operable Unit 4

Revision 0 – November 2012

Appendix A
Data Quality Objectives (DQOs)

APPENDIX A
Data Quality Objectives:
ABS Woodstove Ash Removal Study

A.1 Data Quality Objectives

Data quality objectives (DQOs) define the type, quality, quantity, purpose, and intended uses of data to be collected (EPA 2006). The design of a study is closely tied to its DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and the analyses to be performed. The DQO process typically follows a seven-step procedure, as defined in EPA (2006), to ensure that the project plan is carefully thought out and that the data collected will provide sufficient information to support the key decisions which must be made.

The following sections implement the seven-step DQO process associated with the assessment of potential airborne exposures to LA from woodstove ash removal activities.

A.1.1 Step 1: State the Problem

Wood-burning stoves provide a major source of residential heating in the Kootenai Valley during the cold, winter months. Studies have shown detectable levels of Libby amphibole (LA) on the bark surface of trees located near the former W.R. Grace mine site (CDM Smith 2012; Ward *et al.* 2006) and timber lots near Flower Creek southwest of Libby (Tetra Tech 2011). Residents may harvest and collect firewood from the surrounding National forest land and from private sources. Although local residents have been advised to not harvest trees/wood for residential heating in the Kootenai Valley, it not possible to regulate where an individual might harvest wood for home-heating.

Trial burn experiments in woodstoves (Ward *et al.* 2009) and in test burn chambers (EPA 2012) indicate that the majority of LA fibers are retained in the ash when either wood or duff materials are burned under experimental conditions. Removing ash from woodstoves and disposing the contaminated ash as municipal garbage is a potential exposure scenario for residents in Libby. (An institutional control currently in place already addresses disposal of ash in home gardens to guard against potentially re-contaminating a "cleaned" property.)

Hence, data are required to assess whether residents in Libby would be exposed to unacceptable levels of LA from ash generated from burning contaminated wood in residential wood-burning stoves.

A.1.2 Step 2: Identify the Goal of the Study

This study will seek to assess potential human exposures to LA fibers from sampling conducted to simulate the emptying of ash from a wood-burning stove that was used to burn locally-collected firewood. *The goal of the study is to determine if human exposures to LA associated with woodstove ash removal activities have the potential to result in unacceptable health risks.*

A.1.3 Step 3: Identify the Types of Data Needed

The information needed to characterize exposure of residents to LA in ash consist of reliable and representative measurements of LA in air during woodstove ash removal/cleaning activities. Such measurements are obtained by drawing a known volume of air through a filter during ash disturbance activities and measuring the number of LA fibers that become deposited on the filter surface. This type of sampling is referred to as "activity-based sampling" or ABS.

The following sections discuss the types of disturbance activities that should be evaluated, the types of ABS air samples that should be collected, and the analytical methods that should be used to analyze these ABS air samples.

<u>Disturbance Activities</u>

As noted above, if firewood that contains LA is burned in a woodstove, the LA levels in the resulting ash have the potential to become concentrated. The focus of this study will be on disturbances of this ash material. The highest potential for human contact with the ash is likely to occur while removing the ash from the woodstove for disposal. Thus, this study should seek to evaluate this type of disturbance scenario.

<u>Type of Air Sample</u>

Experience at Libby and at other sites has demonstrated that personal air samples (i.e., samples that collect air in the breathing zone of a person) tend to have higher concentrations of LA than air samples collected by a stationary monitor (EPA 2007), especially if the person is engaged in an activity that disturbs an asbestos source material. Because personal air samples are more representative of breathing zone exposures, to the extent feasible, this study should focus on the collection of personal air samples that are located in the breathing zone of the individual performing the disturbance activity.

<u>Analysis Method</u>

ABS air samples should be analyzed for asbestos using transmission electron microscopy (TEM). Because asbestos toxicity depends on the particle size and mineral type, results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, because it is possible that there could be various sources of LA present, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded. This requirement is based on the observation of Meeker *et al.* (2003) that most particles from the Libby ore body contain detectable levels of both sodium and potassium, whereas other potential sources of LA may not.

Source Material Sampling

Although it is unlikely that an empiric relationship can be developed between measured LA concentrations in the source materials and measured LA concentrations in air, samples of tree bark and ash should be collected and analyzed for LA to support a qualitative evaluation of potential exposures in ABS air as a function of LA levels in the source material.

Other Data

Release of LA from source materials into air is expected to depend on several environmental factors that may tend to vary over time. These factors may include meteorological conditions (e.g., temperature, humidity). It may be helpful to evaluate ABS air concentrations as a function of these environmental factors. Therefore, meteorological weather station data should be downloaded from the National Oceanic Atmospheric Administration (NOAA) station in Libby for days when ABS activities are scheduled.

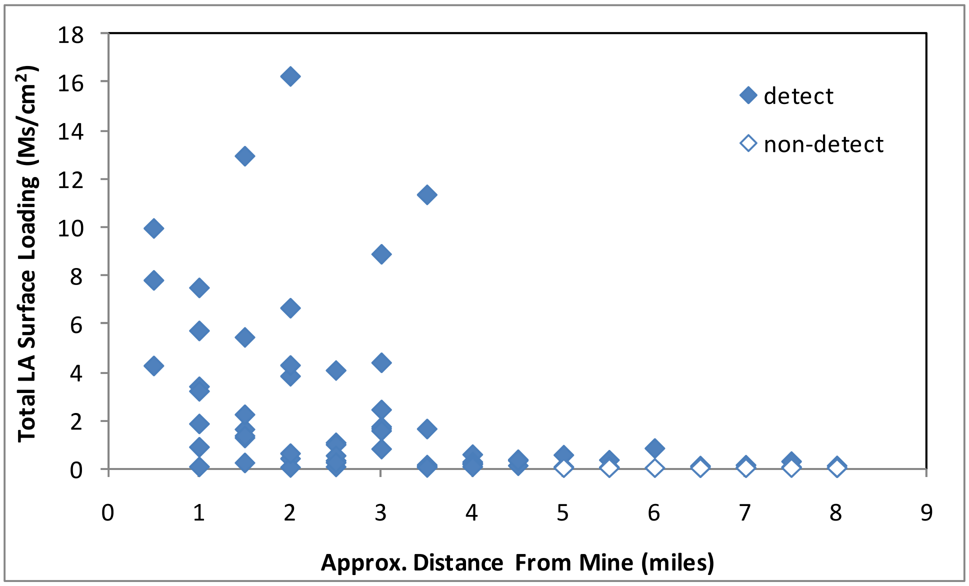
To document the conditions before and during wood burning and ash generation, the initial moisture content of the firewood and temperature readings during the burn should be recorded. The percent wood moisture may be used to compare the moisture content of the firewood from each the three areas and provide an indication of how well the wood can be anticipated to burn. Moisture readings should be taken from a freshly cut face. Temperature readings should be taken periodically during the burn to help assess if the wood is burning within an optimal range. Adjustments to the flue and/or intakes should be made to keep the burn temperature in an optimal range.

A.1.4 Step 4: Define Study Boundaries

Spatial Bounds

Firewood to be burned in the stove will be obtained from locally selected trees collected from areas ranging in distance from the OU3 mine, based on the assumption that LA concentrations in gathered firewood will decrease with increasing distance from the source. This assumption is supported by the available tree bark data collected to date, which shows that surficial loading of LA tends to be highest within 3-4 miles of the mine (see figure below).

Tree Bark Total LA Surface Loading as a Function of Distance from the Mine



Ms/cm² = million structures per square centimeter

Because of the difficulty in establishing a reliable quantitative relation between source materials and ABS air, no attempt will be made to establish an empiric relationship between LA levels in tree bark or ash and the measured concentration in ABS air. Rather, firewood should be collected at multiple locations across the Libby site, selected to be spatially representative of locations where the firewood could be collected at varying distances (e.g., near, intermediate, and far) from the OU3 mine. Resulting data will yield information on the spatial pattern of exposure and risk.

There are several potential options for where the ash removal ABS scenario could be conducted:

1. *Perform in situ ABS at an authentic residential property that has a woodstove.* This approach is likely to be most representative of authentic residential exposure conditions. However, the disadvantages of this approach is that it would require the resident to be displaced from their home for the duration of the study, levels of LA in the ash could be influenced by previous fires (it is unlikely that decontamination of a used woodstove would be able address all potential residual contamination), and measured ABS air concentrations could be influenced by other potential indoor sources of LA present at the residence.

2. *Perform ex situ ABS at a standard, controlled location.* The advantage of this approach is that it provides a direct measure of LA in ABS air during ash removal activities under a controlled set of conditions. In addition, this approach has the advantage that ABS can be conducted in any season at any standardized location (i.e., it is not necessary that ABS be conducted in Libby during the field season). A potential disadvantage of this approach is that local conditions could influence measured air concentrations, but this

issue could be mitigated through the selection of the ABS area and use of appropriate control measures.

Of these two potential study designs, it is likely that the latter approach (i.e., the *ex situ* design) will be the most feasible to implement for the purposes of conducting multiple sampling events on ash materials from various firewood sources under a standardized set of ABS conditions.

Temporal Bounds

Wood-burning stoves are used primarily in the coldest months of the year for home-heating (i.e., October through April), with their use decreasing in the spring time. Thus, ash removal activities are also likely to occur during these months, with the frequency of ash removal depending upon how often the woodstove is used. To the extent feasible, ABS should be performed during this timeframe. However, the study timing will be influenced by the selected study design and study location.

To avoid having long drying times for collected wood (it may take 3 months to a year for green wood logs to season properly for burning), the trees collected for this study should be standing deadwood. This will ensure that wood burning can occur within days after collection, rather than months later. Because rain and snow would increase the moisture content of standing deadwood, wood collection should occur before inclement weather begins. Selected trees should be 8 inches in diameter or larger to ensure that they were present during the mine operation period (pre-1990).

A.1.5 Step 5: Develop the Analytic Approach

ABS data collected as part of this study can be used to estimate exposure and risk from LA in woodstove ash that will support risk management decision-making. The EPA has recently proposed LA-specific toxicity values for use in estimating cancer risks and non-cancer hazard quotients (HQs) from exposures to LA in air. The LA-specific lifetime inhalation unit risk (IUR) value is 0.17 LA phase contrast microscopy (PCM)[1] (structures per cubic centimeter [s/cc])$^{-1}$ and the LA-specific reference concentration (RfC) value is 0.00002 LA PCM s/cc. EPA is currently reviewing these values. The following sections describe how cancer risks and non-cancer HQs will be calculated.

Estimation of Cancer Risk

The basic equation for estimating cancer risk from LA using the LA-specific IUR value is as follows:

$$\text{Risk} = EPC * TWF_c * IUR_{LA}$$

[1] Calculations of human exposure and risk from asbestos in air are expressed in terms of PCM s/cc. When analysis is performed by TEM, structures that satisfy PCM counting rules are referred to as PCM-equivalent (PCME) structures. The PCM counting rules include structures with a length > 5 microns (μm), a width greater than or equal to (≥) 0.25 um, and an aspect ratio ≥ 3:1.

where:

Risk = Lifetime excess risk of developing cancer (lung cancer or mesothelioma) as a consequence of site-related LA exposure.

EPC = Exposure point concentration of LA in air (PCM or PCM-equivalent [PCME] s/cc). The EPC is an estimate of the long-term average concentration of LA in inhaled air for the specific activity being assessed.

TWF_c = Time-weighting factor for cancer. The value of the TWF term ranges from zero to one, and describes the average fraction of a lifetime during which exposure occurs from the specific activity being assessed.

$TWF_c = ET/24 * EF/365 * ED/70$

where:

ET = Average exposure time (hours/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

IUR_{LA}= LA-specific lifetime inhalation unit risk (LA PCM $s/cc)^{-1}$

Estimation of Non-Cancer Hazard Quotient

The basic equation for characterizing non-cancer risk from LA using the LA-specific RfC value is as follows:

$HQ = EPC * TWF / RfC_{LA}$

where:

HQ = Hazard quotient for non-cancer effects from site-related LA exposure

EPC = Exposure point concentration of LA in air (PCM or PCME s/cc)

TWF_{nc} = Time-weighting factor for non-cancer. Note that the interval over which exposure duration is calculated is from age 0 to age 60. This is because the non-cancer toxicity factor is based on cumulative lifetime exposure lagged by 10 years.

$TWF_{nc} = ET/24 * EF/365 * ED/60$

where:

ET = Average exposure time (hours/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

RFC_{LA} = LA-specific lifetime reference concentration (LA PCM s/cc)

Decision Rule

These risk estimates will provide a basis for EPA to determine whether action is needed at the Site to protect human health from exposures to LA in woodstove ash. The EPA guidance provided in Office of Solid Waste and Emergency Response (OSWER) Directive #9355.0-30, "*Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*" (EPA 1991) indicates that if the cumulative cancer risk to an individual based on reasonable maximum exposure (RME) is less than 1E-04 and the non-cancer HQ is less than 1, then remedial action is generally not warranted unless there are adverse environmental impacts. The guidance also states that a risk manager may decide that remedial action is warranted for risk levels lower than 1E-04 where there are uncertainties in the risk assessment results.

A.1.6 Step 6: Specify Performance or Acceptance Criteria

ABS data collected as part of this study will be used to evaluate risks to support risk management decision-making. In making decisions about human health risks, two types of decision errors are possible – false negative and false positive.

- A *false negative decision error* occurs when a risk manager decides an exposure is acceptable when it actually results in unacceptable health risks.

- A *false positive decision error* occurs when a risk manager decides an exposure is unacceptable when it really is acceptable.

EPA is most concerned about guarding against the occurrence of false negative decision errors, since an error of this type may leave humans exposed to unacceptable levels of LA. To minimize chances of underestimating the true amount of exposure and risk, EPA generally recommends that risk calculations be based on the 95 percent upper confidence limit (95UCL) of the sample mean (EPA 1992). Use of the 95UCL in risk calculations limits the probability of a false negative decision error to no more than 5 percent. To support this approach, EPA has developed a software application (ProUCL) to assist with the calculation of 95UCL values (EPA 2010). However, equations and functions in ProUCL are not designed for asbestos datasets and application of ProUCL to asbestos datasets is not recommended (EPA 2008). EPA is presently working to develop a new software application that will be appropriate for use with asbestos datasets, but the application is not yet available for use. Because the 95UCL cannot presently be calculated with confidence, risk calculations will be based on the sample mean only, as recommended by EPA (2008). This means that risk estimates may be either higher or lower than true values, and this will be identified as a source of uncertainty in the risk assessment.

EPA is also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. The risk of false positive decision errors can be minimized by increasing the number of samples. The number of samples needed depends on the magnitude of between-sample variability and the proximity of EPC to the decision rule. If between-sample variability is low, or if the EPC is not near a decision rule, then the number of samples needed is usually relatively low. However, if between-sample variability is high and the EPC is relatively near a decision rule, then the number of samples needed is usually higher.

There is no information available on potential levels of LA in air due to disturbances of woodstove ash. Thus, it is not possible to determine the potential between-sample variability or the proximity of air concentrations to the decision rule. Because it is not possible at present to quantify the uncertainty in the mean of an asbestos dataset as a function of the number of samples, it is not possible to calculate a minimum number of samples required to minimize the risk of false positive decision errors. In general, more samples are needed when there is high between-sample variability and fewer samples are needed when there is low between-sample variability. For the purposes of this study, only one ABS air sample will be collected for each exposure condition (i.e., firewood collected near, intermediate, and far from the OU3 mine) due to budgetary and timing constraints. These ABS results will be evaluated to determine whether subsequent testing and analysis is required to address potential variabilities within each exposure condition.

A.1.7 Step 7: Optimize the Study Design

The following sections present a sampling design for each scenario that will yield data that will address the DQOs specified in Steps 1-6 above.

Sampling Events

As noted above, because it is not possible at present to quantify the uncertainty in the mean of an asbestos dataset as a function of the number of samples, it is not possible to calculate a minimum number of samples required to minimize decision errors. The uncertainty around the mean depends on sample size and on the underlying variability. Thus, it is desirable to perform multiple (3-5) sampling events for each exposure condition to ensure that reliable estimates of long-term average concentrations may be computed from individual short-term measurements of air concentrations during ash disturbance activities. The ABS results from this study will be evaluated to determine whether subsequent testing and analysis is required to address potential variability within each exposure condition.

ABS Air Sampling Approach

Two key variables that may be adjusted during collection of air samples are sampling duration and pump flow rate. The product of these two variables determines the amount of air drawn through the filter, which in turn is an important factor in the analytical cost and feasibility of achieving the target analytical sensitivity (see below). In general, longer sampling times are preferred over shorter sampling times because: a) longer time intervals are more likely to yield representative measures of the average concentration (as opposed to short-term fluctuations); and b) longer collection times are associated with higher volumes, which reduces the number of grid openings that need to be examined to achieve the target analytical sensitivity. Likewise, higher flow rates are generally preferred over lower flow rates because high flow results in high volumes drawn through the filter over shorter sampling times.

ABS personnel should wear two different sampling pumps – a high volume (HV) pump and a low volume (LV) pump. This will allow for the collection of two "replicate" filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes). The appropriate flow rate for each sampling pump should be optimized to achieve the highest sample air volume possible without causing the filter to become overloaded.

The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded, the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter to avoid potential bias associated with indirect preparation[2]. If the low volume filter is deemed to be overloaded, an indirect preparation (with ashing) may be performed.

TEM Stopping Rules for ABS Air Samples

In general, three alternative stopping rules are specified for TEM analyses to ensure resulting data are adequate:

1. The target analytical sensitivity to be achieved
2. A maximum number of structures to be counted
3. A maximum area of filter to be examined

The basis for each of these values for this study is presented below.

Target Analytical Sensitivity

The level of analytical sensitivity needed to ensure that analysis of ABS air samples will be adequate is derived by finding the concentration of LA in ABS air that might be of potential concern, and then ensuring that if an ABS sample were encountered that had a true concentration equal to that level of concern, it would be quantified with reasonable accuracy. This process is implemented below:

2 Indirect preparation has the potential to increase the number of LA structures recorded during TEM analysis, which may bias resulting air concentrations high (Berry *et al.* 2012).

Step 1. Calculation of Risk-Based Concentrations

Cancer. The basic equation for calculating the risk-based concentration (RBC) for cancer is:

$$RBC\ (cancer) = Maximum\ Acceptable\ Cancer\ Risk / (TWF_c * IUR_{LA})$$

For cancer, the maximum acceptable risk is a risk management decision. For the purposes of calculating an adequate target sensitivity, a value of 1E-05 is assumed.

The RME exposure parameters needed to calculate TWF_c were selected based on information from informal interviews with residents that use wood-burning stoves for home heating:

- The time spent emptying ash from a woodstove was assumed to be about 15 minutes per event. Based on local weather conditions in Libby, home heating is assumed to be needed from October through April (about 24 weeks per year). Residents interviewed indicated that they typically empty ash from the stove once or twice per week during the heating season. For the purposes of establishing analytical requirements, it was assumed that a total of 48 stove-emptying events may occur each year.

- No site-specific data exist that provide information on the exposure duration [ED] of area residents. For the purposes of deriving a target analytical sensitivity the ED parameter was estimated to be 50 years.

Based on this exposure information, the TWF_c is 0.00098 (0.25/24 * 48/365 * 50/70 = 0.00098). The proposed IUR_{LA} is 0.17 $(PCM\ s/cc)^{-1}$. Based on these values, the RBC for cancer is 0.060 LA PCME s/cc.

Non-Cancer. The basic equation for calculating the RBC for non-cancer effects is:

$$RBC(non\text{-}cancer) = (Maximum\ Acceptable\ HQ * RfC_{LA}) / TWF_{nc}$$

For non-cancer, the maximum acceptable HQ is 1. Based on this exposure information above, the TWF_{nc} is 0.0011 (0.25/24 * 48/365 * 50/60 = 0.0011). The proposed RfC_{LA} is 0.00002 LA PCM s/cc. Based on these values, the RBC for non-cancer is 0.018 LA PCME s/cc.

Because the non-cancer RBC is lower than the cancer RBC, the non-cancer RBC is used to derive the target analytical sensitivity, as follows.

Step 2: Determining the Target Analytical Sensitivity

The target analytical sensitivity (TAS) is determined by dividing the RBC by the target number of structures to be observed during the analysis of a sample with a true concentration equal to the RBC:

TAS = RBC / Target Count

The target count is determined by specifying a minimum detection frequency required during the analysis of samples at the RBC. This probability of detection is given by:

Probability of detection = 1 – Poisson (0,Target Count)

Assuming a minimum detection frequency of 95 percent, the target count is 3 structures. Based on this, the target analytical sensitivity is:

TAS = (0.018 s/cc) / (3 s) = 0.0058 cc^{-1}

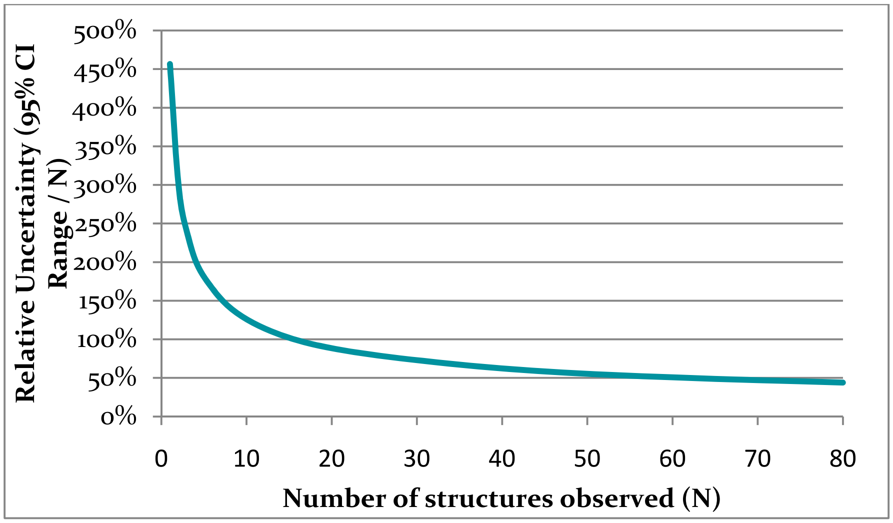
Maximum Number of LA Structures

Ideally, all samples would be examined by TEM until the target analytical sensitivity is achieved. However, for filters that have high asbestos loading, reliable estimates of concentration may be achieved before achieving the target analytical sensitivity. This is because the uncertainty around a TEM estimate of asbestos concentration in a sample is a function of the number of structures observed during the analysis. The 95% confidence interval (CI) around a count of N structures is computed as follows:

Lower bound (2.5%) = ½ · CHIINV(0.975, 2 · $N_{observed}$ + 1)
Upper bound (97.5%) = ½ · CHIINV(0.025, 2 · $N_{observed}$ + 1)

As $N_{observed}$ increases, the absolute width of the CI range increases, but the relative uncertainty (expressed as the CI range divided by Nobs) decreases. This concept is illustrated in the figure below. The goal is to specify a target N such that the resulting Poisson variability is not a substantial factor in the evaluation of method precision. As shown in the figure, above about 25 structures, there is little change in the relative uncertainty. Therefore, the count-based stopping rule for TEM should utilize a maximum structure count of 25 LA structures. Note: This stopping rule is based on the number of PCME LA structures observed (i.e., not total LA structures).

Relationship Between Number of Structures Observed and Relative Uncertainty



Maximum Area to be Examined

The number of grid openings that must be examined (GOx) to achieve the target analytical sensitivity is calculated as:

$$GOx = EFA / (TAS \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

EFA = Effective filter area (assumed to be 385 square millimeters [mm^2])

TAS = Target analytical sensitivity $(cc)^{-1}$

Ago = Grid opening area (assumed to be 0.01 mm^2)

V = Sample air volume (liters [L])

1000 = L/cc (conversion factor in liters per cubic centimeter)

f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Assuming that the sampling duration is 15 minutes and the flow rate is 5 liters/minute (L/min), each ABS air sample should have a sample air volume of 75 L. Assuming that the filter is able to be prepared directly (i.e., f = 1), about 90 grid openings would need to be examined for each ABS air sample to achieve the TAS. If an indirect preparation is necessary, the number of grid openings that will need to be examined is inversely proportional to the dilution needed (i.e., an f of 0.1 will increase the number of grid openings by a factor of 10).

In the event that an indirect preparation is necessary, it is possible that the number of grid openings that would need to be examined to achieve the target analytical sensitivity may become cost or time prohibitive. In order to limit the maximum effort expended on any one sample, a maximum area examined of 10 mm^2 is identified for this project. Assuming that each grid opening has an area of about 0.01 mm^2, this would correspond to about 1,000 grid openings.

Summary of TEM Stopping Rules

The TEM stopping rules for this study should be as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity (0.0058 cc^{-1}) is achieved.
    b. 25 LA structures have been observed.
    c. A total filter area of 10 mm^2 has been examined (this is approximately 1,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

REFERENCES

Berry D, *et al*. 2012. Comparison of Amphibole Air Concentrations Resulting from Direct and Indirect Filter Preparation and Transmission Electron Microscopy Analysis. *[Manuscript in preparation]*

CDM Smith. 2012. Libby Asbestos Superfund Site, Operable Unit 3, Data Summary Report: 2007 to 2011. Prepared for the U.S. Environmental Protection Agency, Region 8. Draft – July.

EPA (U.S. Environmental Protection Agency). 1991. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions.* Washington, DC. OSWER Directive 9355.0-30. http://www.epa.gov/oswer/riskassessment/pdf/baseline.pdf

_____. 1992. *Supplemental Guidance to RAGS: Calculating the Concentration Term.* United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Publication 9285.7-081.

_____. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4.* U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-06/001. February 2006. http://www.epa.gov/quality/qs-docs/g4-final.pdf

_____. 2007. Summary Report for Data Collected under the Supplemental Remedial Investigation Quality Assurance Project Plan Libby, Montana Superfund Site. Prepared for U.S. Environmental Protection Agency, Region 8. Final – October.

_____. 2008. *Framework for Investigating Asbestos-Contaminated Sites*. Report prepared by the Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response, U.S. Environmental protection Agency. OSWER Directive #9200.0-68. http://epa.gov/superfund/health/contaminants/asbestos/pdfs/framework_asbestos_guidance.pdf

____. 2010. ProUCL Version 4.00.05 Technical Guide (Draft). U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/esd/tsc/ProUCL_v4.00.05/ProUCL_v4.00.05_tech_guide(draft).pdf

_____. 2012. Preliminary Results from High- and Low-Temperature Burn Trials of Forest Duff from the OU3 mine site. *(unpublished results)*

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

Tetra Tech. 2011. Libby Amphibole (LA) Asbestos in Tree Bark and Duff in the Upper Flower Creek Timber Sale Site, Libby, Montana. Prepared for the Montana Department of Environmental Quality and the Montana Department of Natural Resources and Conservation. Draft – December.

Ward TJ, Spear T, Hart J, Noonan C, Holian A, Getman M, Webber JS. 2006. Trees as reservoirs for amphibole fibers in Libby, Montana. *Sci Total Environ.* 367(1):460-465.

Ward, TJ, Hart JF, Spear TM, Meyer BJ, and Webber JS. 2009. Fate of Libby Amphibole Fibers When Burning Contaminated Firewood. *Environ Sci Technol.* 43(8): 2878–2883.

Sampling and Analysis Plan/Quality Assurance Project Plan: Wood-Burning Stove Ash Removal Activity-Based Sampling Libby Asbestos Site, Operable Unit 4

Revision 0 – November 2012

Appendix B
Standard Operating Procedures (SOPs)

SOP ID	SOP Description
Field Procedures	
CDM-LIBBY-09	GPS Coordinate Collection and Handling
EPA-LIBBY-2012-01	Field Logbook Content and Control
EPA-LIBBY-2012-02	Photographic Documentation of Field Activities
EPA-LIBBY-2012-04	Field Equipment Decontamination
EPA-LIBBY-2012-05	Handling Investigation-Derived Waste
EPA-LIBBY-2012-06	Sample Custody
EPA-LIBBY-2012-07	Packaging and Shipping of Environmental Samples
EPA-LIBBY-2012-10	Sampling of Asbestos Fibers in Air
EPA-LIBBY-2012-12	Sampling and Analysis of Tree Bark for Asbestos
Laboratory Procedures	
EPA-LIBBY-08	Indirect Preparation of Air and Dust Samples for TEM Analysis
EPA-LIBBY-2012-11	Sampling and Analysis of Duff for Asbestos
EPA-LIBBY-2012-12	Sampling and Analysis of Tree Bark for Asbestos
Data Verification Procedures	
EPA-LIBBY-09	SOP for TEM Data Review and Data Entry Verification
EPA-LIBBY-11	SOP for FSDS Data Review and Data Entry Verification

The most recent versions of all field SOPs are provided electronically in the Libby Field eRoom (https://team.cdm.com/eRoom/R8-RAC/Libby).
The most recent version of all laboratory and data verification SOPs are provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).

Sampling and Analysis Plan/Quality Assurance Project Plan: Wood-Burning Stove Ash Removal Activity-Based Sampling Libby Asbestos Site, Operable Unit 4

Revision 0 – November 2012

Appendix C
ABS Script

APPENDIX C
ABS Script for Woodstove Ash Removal Activities

Activity-based sampling (ABS) activities will be conducted in a temporary 10 foot by 10 foot tent enclosure constructed at the Libby landfill. A new EPA-certified woodstove suitable for home use will be installed in the temporary enclosure. The woodstove shall be set up and seasoned per the manufacturer's instructions. The temporary structure will be constructed of posts with polyvinyl sheeting to serve as walls. Due to the potential heat generated by the woodstove during burning, the temporary walls will only be in place for the ABS stove-emptying activities. During wood burning, the enclosure will not have any walls so that the heat generated by the stove can dissipate in the open air.

Prior to burning, the moisture content of the firewood will be determined using a wood moisture meter. A minimum of three readings from freshly cut faces of the internal portions of the wood shall be taken and recorded in the field logbook. Tree bark samples should be collected prior to placement in the woodstove. Firewood will be continuously burned in the woodstove over a six-hour period. Temperature readings shall be taken periodically and recorded in the field logbook, including the maximum temperature observed and readings typical of the temperature during the course of the burn. The amount of wood burned will be tracked so that the same general amount of wood is used for subsequent burning events. After the six-hour period, the ash should be allowed cool. The ash sample should be collected prior to conducting the ABS activity.

Prior to the ABS activity, the temporary polyvinyl walls should be erected enclosing the woodstove with the woodstove's ventilation routed to the outdoors similar to how it would be installed in a home. During the ABS activity, one actor will empty out the ash from the woodstove using a long-handled metal shovel, placing the ash material into a metal ash bucket. Once all of the ash has been shoveled out, a soft-bristled brush should be used to sweep up and gather any additional ash material for removal and placed into the ash bucket. There is no specified sampling duration requirement for this ABS scenario. Rather, the actor should continue removing ash until all ash has been removed (regardless of how long this activity takes). Once all ash has been removed from the stove, the sampling pumps may be turned off and the air cassettes can be removed. Sampling pump flows should be checked at the beginning and end of the ABS scenario.

A total of three stove-emptying events will be performed for each firewood collection areas (see Figure B-2 in the main text for an illustration of the study design). Woodstove decontamination should be performed between each stove-emptying event. Enclosure walls should be decontaminated or replaced before conducting the next stove-emptying activities. It is estimated that each event (from wood burning to stove-emptying) will take approximately three days (one day for burning, one day to allow the ash to cool, and one day to perform the ABS).

Sampling and Analysis Plan/Quality Assurance Project Plan: Wood-Burning Stove Ash Removal Activity-Based Sampling Libby Asbestos Site, Operable Unit 4

Revision 0 – November 2012

Appendix D
Analytical Requirements Summary Sheet
[ASHOU4-1012]

The most recent version of the Analytical Requirements Summary Sheet
is provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).

SAP/QAPP REQUIREMENTS SUMMARY #ASHOU4-1012
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Libby Asbestos Site, OU4, Sampling and Analysis Plan/Quality Assurance Project Plan, Wood-Burning Stove Ash Removal ABS

SAP Date (Revision): November 2012 (Revision 0)

EPA Technical Advisor: Elizabeth Fagen (303-312-6095, Fagen.Elizabeth@epa.gov)
(contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: This program will conduct activity-based sampling (ABS) during activities representative of ash removal from a wood-burning stove. As part of this program, ABS air samples will be collected during the ABS activity and analyzed by TEM-ISO. Prior to the ABS effort, tree bark and ash samples will be collected. Tree bark samples will be collected and analyzed for asbestos by TEM-ISO (following preparation by SOP EPA-LIBBY-2012-12). Ash samples will be collected and analyzed for asbestos by TEM-ISO (following preparation by SOP EPA-LIBBY-2012-11). Two types of perimeter air samples will be collected – a 6-hour sample during the wood-burning activity for analysis by TEM-AHERA and a 3-day sample over the duration of the ABS event for analysis by TEM-ISO.

Estimated number of field samples (sampling is expected to occur in early November):

>> Tree Bark: 10 samples
>> Ash: 9 samples
>> ABS Air: 9 samples
>> Perimeter Air, 6-hour sample: 3 samples ***[24-hour turn-around required]***
>> Perimeter Air, 3-day sample: 3 samples

Sample ID Prefix: WA-_ _ _ _ _

1. AIR

TEM/PCM Preparation and Analytical Requirements for Air Field Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? [a,b] With Ashing	Indirect Prep? [a,b] Without Ashing	Filter Archive?	Method	Recording Rules [c]	Analytical Sensitivity/Prioritized Stopping Rules	
A	Air, Perimeter 6-hour	No	No	Yes	Yes	TEM-AHERA	All asbestos; L $\geq$ 0.5 µm AR $\geq$ 5:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 0.005 cc^{-1} is achieved. [d] ii) 25 LA structures are recorded	LB-000029, LB-000031, LB-000067, LB-000085

Medium Code	Medium, Sample Type	Preparation Details: Investi-gative?	Preparation Details: Indirect Prep? [a,b] With Ashing	Preparation Details: Indirect Prep? [a,b] Without Ashing	Preparation Details: Filter Archive?	Analysis Details: Method	Analysis Details: Recording Rules [c]	Analysis Details: Analytical Sensitivity/Prioritized Stopping Rules	Applicable Laboratory Modifications (current version of)
B	Air, Perimeter 3-day	Yes	Yes	No	Yes	TEM – Modified ISO 10312	All asbestos; L: ≥ 0.5 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 0.00004 cc^{-1} is achieved. [d] ii) 25 LA structures are recorded	LB-000016, LB-000029, LB-000055, LB-000066D, LB-000067, LB-000085
C	Air, ABS	Yes	Yes	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 0.0058 cc^{-1} is achieved ii) 25 PCME LA structures are recorded iii) 20 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066D, LB-000067, LB-000085
D	Air, Health & Safety	No	No	Yes, if material is overloaded (>25%) or unevenly loaded on filter	Yes	PCM – NIOSH 7400, Issue 2 TEM– AHERA (upon request)	For PCM: NIOSH 7400, "A" rules If AHERA is requested: All asbestos; L ≥ 0.5 µm AR ≥ 5:1	For PCM: Count a minimum of 20 FOVs, then continue counting until one is achieved: i) 100 fibers are recorded ii) 100 FOVs are examined (regardless of count) For AHERA: Examine 0.1 mm^2 of filter	For PCM: LB-000015 For AHERA: LB-000029, LB-000031, LB-000067, LB-000085

[a]The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare the high volume filter indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.
[b] See most current version of SOP EPA-LIBBY-08 for indirect preparation details.
[c] If observed, chrysotile structures should be recorded using the same procedures as amphibole asbestos.
[d] Contact the laboratory coordinator if the target sensitivity cannot be achieved in 100 GOs for specific direction on how to proceed.

TEM Preparation and Analytical Requirements for Air Field Quality Control Samples:

Medium Code	Medium, Sample Type	Preparation Details			Analysis Details			Applicable Laboratory Modifications (current version of)
		Indirect Prep?		Archive?	Method	Recording Rules	Stopping Rules	
		With Ashing	Without Ashing					
E	Air, lot blank and field blank	No	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Examine 1.0 mm^2 of filter.	LB-000016, LB-000029, LB-000066D, LB-000067, LB-000085

2. ASH

TEM Preparation and Analysis Requirements for Ash Samples:

Medium Code	Medium, Sample Type	Preparation Details [e]				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep?		Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Prioritized Stopping Rules	
			With Ashing	Without Ashing					
F	Ash, Filter	Yes	Yes	No	Yes	TEM – Modified ISO 10312 (see Section 6.2.3 of SOP EPA-LIBBY-2012-11)	All asbestos; L: ≥ 0.5 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 1E+07 g^{-1} is achieved ii) 50 LA structures are recorded iii) 1.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066D, LB-000067, LB-000085

[e] Prepare samples in accordance with the procedures in SOP EPA-LIBBY-2012-11 (see Section 6). A total of three replicate filters will be created for each ash sample using separate aliquots of the ash residue. Any remaining ash material should be archived for possible future analysis.

3. TREE BARK

TEM Preparation and Analysis Requirements for Tree Bark Samples:

Medium Code	Medium, Sample Type	Preparation Details [f]				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? With Ashing	Indirect Prep? Without Ashing	Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Prioritized Stopping Rules	
G	Tree Bark, Filter	Yes	Yes	No	Yes	TEM – Modified ISO 10312 (see Section 6.2 of SOP EPA-LIBBY-2012-12)	All asbestos; L: ≥ 0.5 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 100,000 cm^{-2} is achieved ii) 50 LA structures are recorded iii) 1.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066D, LB-000067, LB-000085

[f] Prepare samples in accordance with the procedures in SOP EPA-LIBBY-2012-12 (see Section 6). A total of three replicate filters will be created for each tree bark sample (see Section 6.1, *Preparation of Replicate Filters*, for detailed information on preparing replicate filters). Archive all remaining ash material for possible future analysis.

4. EQUIPMENT RINSATE WATER

*****All equipment rinsate samples will be archived pending the results of the tree bark samples; EPA will provide direction if/when samples should be analyzed***

TEM Preparation and Analytical Requirements for Water Samples:

Medium Code	Medium	Preparation Details [g]				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? With Ashing	Indirect Prep? Without Ashing	Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Stopping Rules	
H	Rinsate Water	Yes	No	No	Yes	Standard TEM; ISO 10312	All asbestos; L: ≥ 0.5 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 50,000 L^{-1} is achieved ii) 25 structures are recorded iii) A total filter area of 1.0 mm^2 has been examined (approx. 100 grid openings)	LB-000016, LB-000029, LB-000066D, LB-000067, LB-000085

[g] Sample and filter preparation should be performed in basic accordance with EPA Method 100.2 (as modified by LB-000020). Grid preparation should be performed in basic accordance with Section 9.3 of ISO 10312:1995(E).

Analytical Laboratory Quality Control Sample Frequencies:

TEM [h]: Lab Blank – 4%
Recount Same – 1%
Recount Different – 2.5%
Verified Analysis – 1%
Interlab – 0.5% [i]
Repreparation – 1%

Addtl TEM, for tree bark and ash:
Laboratory Blank – 3% (or 1 per prep batch)
Filtration Blank – 2% (or 1 per prep batch)
Laboratory Duplicate – 5%

PCM [j]: Blind Recounts – 10%

[h] See LB-000029 for selection procedure and QC acceptance criteria.
[i] *Post hoc* selection to be performed by the QATS contractor.
[j] See NIOSH 7400 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	10/19/2012	---
1	11/2/2012	• Revised finalization date for associated SAP (November 2012). • Added LB-000055 as an applicable mod for the 3-day perimeter air samples. • Added detail for tree bark and ash to clarify the number of filter replicates to be prepared for each sample.

Analytical Laboratory Review Sign-off:

☒ EMSL – Libby [sign & date: R.K. Mahoney 23 October 2012]
☒ EMSL – Cinnaminson [sign & date: R.Denton 26 October 2012]
☒ EMSL – Beltsville [sign & date: Joseph Centifonti 24 October 2012]
☒ EMSL – Denver [sign & date: Erin_ Orthun _25_September_2012]

☒ ESAT [sign & date: __Douglas_Kent_23_October_2012_]
☒ Hygeia [sign & date: _Kyeong Corbin 29 October 2012__]
☒ RESI [sign & date: __Jeanne Spencer 26 October 2012__]

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified SAP.]